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FLIGHT

AIRCRAFT, SPACECRAFT, MISSILES

Official Organ of the Royal Aero Club First Aeronautical Weekly in the World Founded 1909

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The DC-3—and After

WITH our journal so preoccupied with the problems of the present and the future, it might appear that a staff artist would be misemployed in making a slap-up cut-away drawing of a 25-year-old aeroplane. But when, some weeks ago, we decided to give the full *Flight* treatment to the Douglas DC-3 (with the result that appears on pages 982-983), we did so for reasons that were not wholly sentimental. Our artist, Arthur Bowbeer, warmed greatly to his task in the knowledge that he was recording for coming generations the technical make-up of the most famous airliner ever built, just as his chief, Max Millar, has put on paper all the functional beauty of the greatest of the clipper ships. But when Mr Bowbeer sharpened his pencil at LAP and sized up one of BEA's last Pionairs, he did so in the hope that his drawing would prove not only instructive to future aircraft builders (as it cannot fail to do) but that it would afford the same pleasure that is given by a well-done portrait of a well-loved person—and one who is celebrating a 25th birthday.

As a setting for the drawing we have the text by Mr Peter Brooks, who brings to his task not only his researches as an air historian but his experience as a senior executive of BEA. Mr Brooks reminds us that no transport aeroplane has a history even remotely comparable with that of the DC-3. It might be safe to predict that none will ever again establish itself so deeply in world esteem. When Mr Brooks puts his BEA hat on, however, we believe that he looks ahead to aircraft that will render no less a service. The de Havilland Trident, in our estimation, will prove to be an aeroplane of the same sterling character as the "Dak" in that it will offer economy, integrity and potential growth, and will open up entirely new operational possibilities. The same can be said of the Vickers VC11. True, there is great disappointment that no Tridents have yet been ordered by airlines other than BEA and that the VC11 has won only an option. True that the first great orders in this field have gone to America. True also that Douglas—constructors of the world's most successful airliner—made a loss last year (though their biggest rivals acknowledge that this was because of a very rigid system of accounting). True, nevertheless, that Douglas, like the rest of us, find themselves in a business wherein literally anything can happen—just as the DC-3 happened at the right time and place in history.

Dickens and Us

AEROPLANES Past. Aeroplanes Present. Both have occupied our thoughts on this page. Now for Christmas Present. Scrooge, we remember, dreamed that he had had his Christmas Present in the biggest possible way. Yet he woke up to find a sparkling Christmas morning—and he was not too late to nip out and buy the biggest turkey in the market and pack it off to Bob Cratchit. If all of us in the aircraft industry nip smartly out into the market we shall find people ready to talk turkey. Unless we do, there are going to be more Cratchits about next Christmas.

Anyway, the cosy old tale of Dickens' *Christmas Carol* will never be forgotten. Another of his works, called *Hard Times*, seems to be less popular these days. We must hope that people are judging the books on literary merit.

Being in the writing business ourselves we have an equal opportunity with Dickens to put our thoughts across. What we are thinking now has been written before, yet even our esteemed sub-editor is not likely to pounce upon it as a cliché:

★ ★ ★ *A MERRY CHRISTMAS AND A HAPPY NEW YEAR*

FROM ALL QUARTERS

TAKE-OVER: The first Armstrong Whitworth Argosy of Riddle Airlines' order for seven was formally handed over at Bitteswell Airfield on December 12. In the picture are, left to right, Mr R. A. Courtman, AWA executive assistant; Mr E. D. Keen, executive director and chief designer; Capt D. Ohlfest, Riddle; Capt H. Davis, Riddle chief test pilot (receiving log-book from Mr Keen); Mr C. W. Simpson, AWA test pilot; Mr M. F. Thomson, Riddle navigator

Lost Indian Orders

IN the House of Commons on December 12 the Parliamentary Secretary to the MoA, Mr Geoffrey Rippon, agreed with Mr John Cordle (Con, Bournemouth East and Christchurch) that there was concern in the British aircraft industry at the loss to Russia of an important Indian contract for helicopter and heavy transport aircraft. He said it was the Minister of Aviation's constant endeavour to assist the industry's export drive by all means at his disposal.

When Mr Cordle said, "We have lost this contract and a certain amount of goodwill through inefficiency and failure to seize an opportunity. Will you take steps with the industry to see that this failure is not repeated?" Mr Rippon replied that negotiations had not yet been finally concluded. He said he would not expect the purchase from Russia to set a pattern and he hoped the United Kingdom would remain the main supplier of aircraft to India.

More for Man-powered Flight

MR HENRY KREMER has contributed £2,500 to the Man-powered Aircraft Group of the Royal Aeronautical Society. The Society announced in June that the Group had received donations totalling £1,100 and would consider making financial contributions to one or more persons or organizations who submitted promising projects to further the achievements of man-powered flight. Up to October 31 (closing date for submitting projects), some half-dozen had been received and these are being considered by the Group's committee.

N. E. Rowe Succeeds J. D. North at ARB

IT is announced that Mr N. E. Rowe, CBE, DIC, BSc, has been appointed to the Air Registration Board as representative of the aircraft constructors. He fills the vacancy caused by the retirement of Mr J. D. North. Now joint managing director of Blackburn Aircraft Ltd, Mr Rowe joined the Royal Aircraft Establishment in 1924, becoming Chief Technical Officer at Martlesham Heath in 1937. He was Deputy Director, Aeronautical Engineering, at Air Ministry from 1938 to 1940 and in 1941 appointed Director-General of Technical Development at the MAP. After his resignation from the Civil Service he was controller of research and special developments with British European Airways from 1946 to 1951. He was 1955-56 president of the Royal Aeronautical Society and president of the Helicopter Association of Great Britain in 1959.

DARWINIAN THEORY: Evolution of the Boeing 727 (described in last week's issue) is apparent in this photograph showing a study model in the hands of Wellwood E. Beall (right), senior vice-president, and George R. Sanborn, Transport Division director of commercial sales. The earlier configurations in the rear have two, three and four engines

Nuclear News

BRIEF details have been given by the University of California of the preparation of pure compounds of californium at the Lawrence Radiation Laboratory at Berkeley. Not occurring naturally, californium fissions with incredible efficiency, each split producing 3.5 neutrons. Chain-reactions could be sustained with critical masses "as small as a bullet," which would become super-critical on impact with the target. Yield would be about 10t.

On the 19th anniversary of Pearl Harbour, the US Government released photographs of the two atomic bombs dropped on Japan in 1945. "Little Boy" (Hiroshima, August 5) had a sub-critical mass of U_{235} detonated by the firing into it of a single additional piece. With a yield of about 20kT, the bomb was 28in diameter, 120in long and weighed about 9,000lb. "Fat Boy" (Nagasaki, August 9) had a filling of Pu_{239} triggered by the implosion principle; also of 20kT yield, it had a diameter of 60in, length of 128in and weight of about 10,000lb.

Prof W. J. Duncan

WE record with regret that Prof W. J. Duncan, CBE, DSc(Eng), FRS, Hon FRAeS, who had been Professor of Aeronautics and Fluid Mechanics at the University of Glasgow since 1950 and was chairman of the Aeronautical Research Council and the Commonwealth Advisory Aeronautical Research Council, died on December 9 at the age of 66.

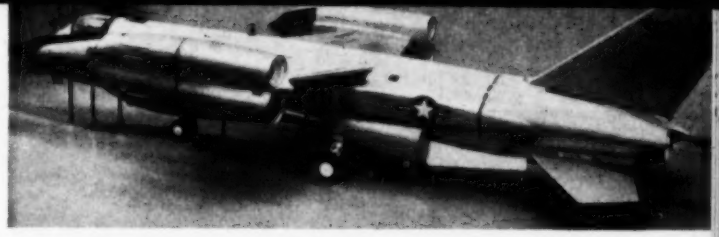
His initial experience of aircraft engineering came in the First World War, when, after service in the RASC, he was transferred to the Aeronautical Inspection Department. After spending seven post-war years in marine engineering, he became a researcher in the aerodynamics department of the NPL in 1926, being largely concerned with aircraft structures. In conjunction with Dr R. A. Frazer, he was mainly responsible for the development of the classical theory of flutter.

When in 1934 he became head of the Department of Aeronautics at Hull University College (becoming Wakefield Professor in 1938), he came into close contact with Blackburn Aircraft at Brough. During the Second World War he was attached to the RAE as head of the Air Defence Research Department at Exeter; then in 1946 became Professor of Aerodynamics at the College of Aeronautics, Cranfield, on its formation, occupying this Chair until his appointment at Glasgow in 1950. In 1954 he acted as one of the assessors at the Comet inquiry. He was elected Fellow of the Royal Society in 1947, appointed CBE in 1953 and in May this year made an Honorary Fellow of the Royal Aeronautical Society.

Camphill's Silver Jubilee

TWENTY-FIFTH anniversary of Derbyshire and Lancashire Gliding Club was celebrated at a dinner and dance in Buxton on Friday, December 9. Guest of honour was Philip Wills, who brought along his first gliding logbook from which to recall some of the early flights which he, and the Camphill pioneers, had made over the Derbyshire countryside of "small tennis-court fields surrounded by stone walls."

On a theme of "those were the days," Mr Wills outlined a



***EIGHT BELLS:** Stemming from the defunct XF-109 fighter project of the USAF, the D-188A mock-up was recently unveiled by Bell Aerosystems Corp in Buffalo, NY. Eight turbojets—two vertical, two horizontal and four tilting—confer VTOL ability, coupled with a horizontal speed of M2. Bell are seeking a USAF order for "a small batch"*

memorable 1936 which included breaking his glider's nose on hitting a concealed rock on landing; a spiral dive out of cloud at 115 m.p.h.; writing-off a wing; and overturning on landing. After the 1937 Wasserkuppe contest, he came back to "the first real competition for gliding in this country."

The Derbyshire and Lancashire club, he said, had discovered the first proper approach to competition flying; the best landlord the gliding movement had ever had (Mr H. C. Bowles); and Terence Horsley, "who created the Kemsley Flying Trust." It was at Camphill, also, that the basic principles of contest task-flying had been established. Among what the speaker described as other "odd nice things" possessed by the club was Basil Meads, Derby and Lancs chairman for each of its 25 years and secretary of the Kemsley Flying Trust.

Proposing the health of the guests, Mr J. B. Jefferson paid tribute to two aspects of Philip Wills' gliding activity—(1) his flying skill, and (2) his work as ambassador of gliding to the outside world. He had skilfully piloted not only his aircraft but also the entire gliding movement. Third speaker at the dinner was Mr Meads, who praised the unique club spirit at Camphill.

L. R. Barratt Retires

MR L. R. BARRATT, OBE, AFRAeS, retired from the MoA recently as Assistant Director in the Technical Cost Branch. He had held this position (previously with the Ministry of Supply) since 1948, and his experience in technical costing—successively with the Admiralty, Air Ministry, MAP, MoS and MoA—went back thirty-five years. In the pre-war period, he was concerned with costs of many types of both aircraft and engines; during the war, he carried out liaison with Canadian aviation companies; and in 1946 he was a member of a four-man commission which went to advise the Government of India on the formation of an aircraft industry.

IN BRIEF

Sales of engines and spares abroad by the British aircraft industry from January to October this year, totalling £60,759,059, were a record for a ten-monthly period. They represent an annual figure of £73m, compared with 1959's record £64½m.

Mr Arnold Lindley, vice-chairman and managing director, is succeeding Sir Leslie Gamage as chairman of the General Electric Co Ltd at the end of this year, on the latter's retirement. Mr Lindley, who has been on the G.E.C. board since 1953 and became vice-chairman and managing director last year, is to continue as managing director.

The Secretary of State for Air was asked in the Commons on December 7 whether he would assist the plans for establishing a Commonwealth gliding centre at Lasham airfield. Mr W. J. Taylor, Under-Secretary of State for Air, replied: "I have already offered to sell this airfield to the Lasham Gliding Society. . . . I am at present discussing the matter with my right hon Friend the Minister of Aviation."

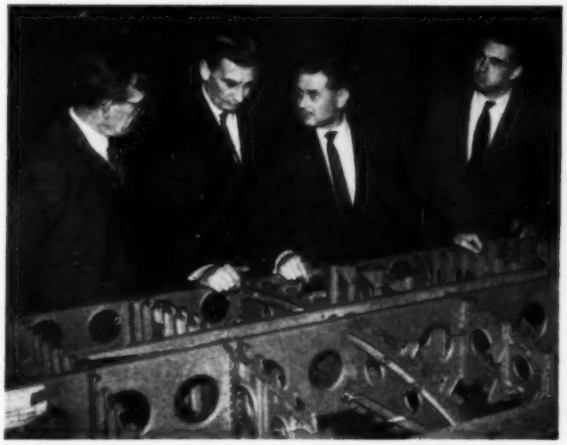
The Young People's Lecture of the Royal Aeronautical Society is to be given on January 5 by Mr R. J. Lees, head of the RAE's Instrument and Photographic Department. Entitled *Gyroscope and Pendulum—the Modern Travel Agents*, it will include a simple explanation of inertial navigation principles. The venue is the RAeS lecture theatre at 4 Hamilton Place (near Hyde Park Corner) and the time 3 p.m. Admission is by ticket, free on prior application.

Lt Cdr J. S. Sproule has been appointed assistant sales representative of Blackburn Engines Ltd, based at the company's London office. Lt Cdr Sproule, who retired from the Royal Navy in September, commanded No 700 Sqn "H" Flight for intensive flying trials of the Whirlwind Mk 7. Another of his Royal Navy appointments was that of commander of the helicopter search and rescue flight at RNAS Ford. While there he developed the scoop net rescue device, and also designed and developed helicopter arrester gear and other equipment.

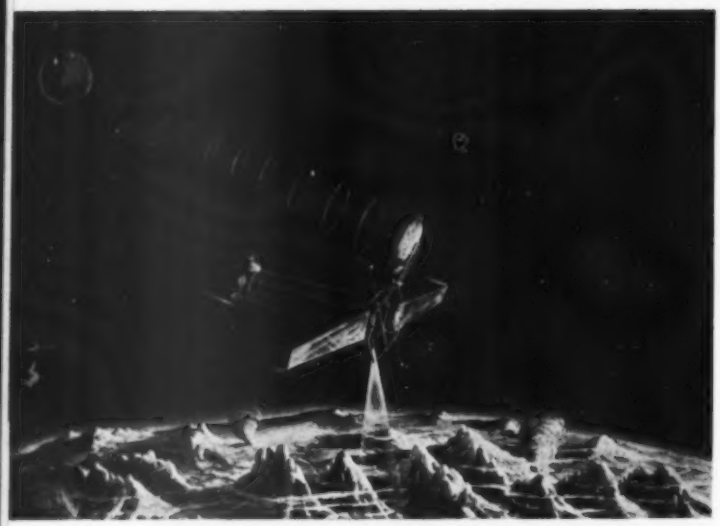
To mark the start of its seventh year and use of a new meeting-place, the London Society of Air-Britain is holding an international film show on Wednesday, January 4, from 7 to 10 p.m., in the recently opened lecture hall of the Holborn Central Library, Theobald's Road (near the junction with Gray's Inn Road), London WC1. The programme will include two new colour films of French civil and military aircraft, a Czech feature on the Tu-104A, an Indian picture called *Flying Sailors*, a New Zealand documentary on crop dusting, the Rolls-Royce picture *Magic of a Name*, and a colour film on NATO air forces. The meeting will be opened by Sqn Ldr H. G. Hazelden, chief test pilot of Handley Page and the London Society's president. Details of the meeting (and of the society) are obtainable from Mr John S. M. Larkham, 43 Midhurst Road, West Ealing, London W13.

***WELCOME GUEST** at the annual dinner of Flight Refuelling Ltd at Bournemouth was Col A. Parot of the Royal Belgian Air Force, seen here being greeted by Sir Alan Cobham (chairman and managing director) and Lady Cobham. The event celebrated the company's 26th anniversary, and 650 staff-members and friends were present*

***ARRIVING BY DOVE** for a visit to Bristol Siddeley's Patchway, Bristol, works: Sir George Gardner, Controller of Aircraft, MoA (centre) and his Deputy, Mr M. B. Morgan (right). They were greeted by Sir Arnold Hall, Bristol Siddeley managing director*



***SKYVAN TAKING SHAPE:** Studying wing structure at Short Brothers and Harland's Light Aircraft Division are two visitors from Silver City Airways, Mr M. D. Day, operations director (second from left) and Mr R. Nichol, operations assistant (extreme right). With them are Mr D. Keith-Lucas (extreme left), Short's technical director, and Mr F. H. Robertson, chief engineer, Light Aircraft Division*



Project Mariner spacecraft for early planetary-probe missions to Mars and Venus. Launch vehicle will be Centaur

Missiles and Spaceflight

EXPLORING THE PLANETS

UNMANNED exploration of the solar system forms an important part of the United States' space programme, both in providing new scientific knowledge and in establishing a sound basis for manned spaceflight. This review of the National Aeronautics and Space Administration's planning for the instrumented exploration of the Moon, planets and interplanetary space is based on a paper presented earlier this year by Mr Edgar M. Cortright, Assistant Director for Lunar and Planetary Programs in the NASA Office of Space Flight Programs.

The broad scientific objectives may be listed as: (1) Physics of the Moon and planets; (2) solar and interplanetary physics; (3) biosciences and extra-terrestrial life; and (4) cosmology. Physics of the Moon and planets is comparable to geophysics of the Earth, and includes studies of atmospheres, ionospheres, trapped radiation, magnetic and gravitational fields, and properties of the surface and subsurface. Solar and interplanetary physics is concerned with the solar atmosphere and radiations, and with the properties of interplanetary space as influenced by the Sun, the solar system itself, and external sources.

Biosciences encompasses not only the search for extra-terrestrial life but also the study of the behaviour and propagation of Earth life-forms in extra-terrestrial environments. Cosmology is the effort to put all of the pieces of the puzzle together toward a better understanding of the nature and origin of the solar system and of the universe itself.

In carrying out this scientific programme the following technological areas are expected to benefit and be developed directly: (1) Navigation, guidance and control; (2) long-range communication; (3) entry into planetary atmospheres; (4) remote landings on the Moon and planets; (5) surface transportation techniques in strange environments; and (6) utilization of natural resources which are yet to be found.

To achieve these scientific and technological aims, the NASA schedule has been guided by two main principles. Firstly, to select a limited number of important goals on which to concentrate. Secondly, to establish an evolutionary sequence of missions in which each step paves the way for the more difficult phase to follow, making full use of new developments in technology. The resulting plan is illustrated below.

The first lunar missions to be attempted involve lunar orbiters, two of which were planned to be launched by Atlas-Able this year. The first launch (September 25) was unsuccessful, and a second attempt is due this month (see description in last week's issue). The second series of lunar missions is planned for 1962 with three lunar-impact launchings by Atlas-Agena.

Third and most extensive of the series of lunar missions is that employing soft-landing spacecraft, at first using Centaur launch vehicles and transferring to Saturn in the second half of the decade. At about this time it is possible that an advanced lunar orbiter will be utilized as a prelude to detailed exploration with a mobile surface vehicle.

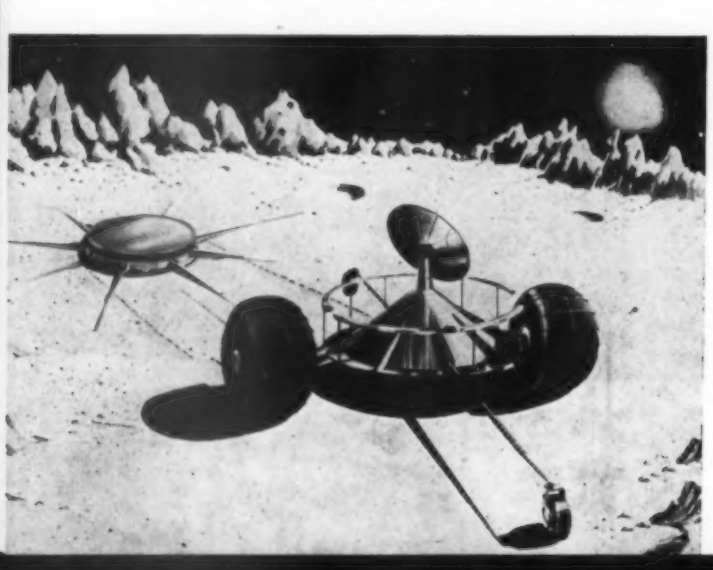
The programme of planetary exploration should become active with the first practical opportunities for launchings to Mars and Venus. It is planned to launch spacecraft to fly close to these planets and obtain scientific observations both of the planets and of the interplanetary environment en route. Early missions would employ Centaur, followed by Saturn.

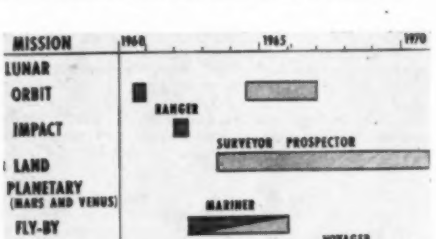
The basic Saturn planetary mission being considered is for a spacecraft to orbit the planet and to release a probe which would descend into the planetary atmosphere and perhaps to the planetary surface. Data would be relayed back to Earth via the orbiting spacecraft.

Beyond these missions it is probable that flights to other planets (Mercury and Jupiter) will be attempted, as the appropriate propulsion becomes available, and that full-sized spacecraft will descend through the planetary atmospheres to land. Electrical propulsion shows definite promise for these more difficult missions.

Solar and interplanetary investigations are already active. The first such launching was that of Pioneer 5, and a second should be attempted near the end of this year with a relatively small payload on a Thor-Delta vehicle. During 1961 spacecraft for use on Atlas-Agena vehicles are planned to be launched into deep space, both as spacecraft development tests and to obtain interplanetary scientific data. Among the more-advanced missions are the highly elliptical solar orbit and the wide excursion from the ecliptic.

The first lunar orbiter spacecraft was described and illustrated in *Flight* of December 16, 1960. This will be followed by the spacecraft illustrated in column 1, page 969, which is intended for use in lunar, planetary and interplanetary missions at a gross weight of 600-1,200lb. This particular version will be used as shown on interplanetary missions launched with Atlas-Agena vehicles in an early phase of Project Ranger. Although the primary purpose of these flights is to test the spacecraft and component developments, a set of seven scientific experiments has been approved for flight. A version differing primarily in the instrumentation carried will be used on the early planetary missions to Mars and Venus, under the name Project Mariner.





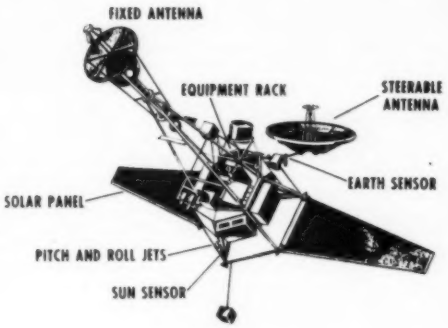
Above, NASA programme plan for lunar, planetary and interplanetary exploration by instrumented probes. Left, lunar landing by Prospector spacecraft with mobile laboratory

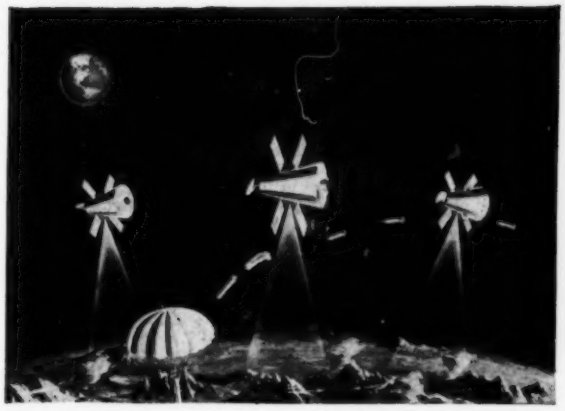
The lunar impact missions, which conclude Project Ranger, will also use a modified version of this spacecraft which is being designed to carry a survivable capsule containing a seismometer as the primary experiment. The spacecraft is being developed by the Jet Propulsion Laboratory and the capsule is under contract to Aeronutronics Division of Ford Motor Co.

During the early stages of the flight, the spacecraft is designed to maintain three-axis attitude control with its antenna pointing toward the Earth and its solar panels toward the Sun. Radio tracking reveals any necessary course corrections, which the spacecraft then makes on command by orienting itself for a mid-course rocket firing and then reorienting itself with its principal axis toward the Sun for travel through cislunar space.

As the spacecraft approaches the lunar surface, it orients itself on command along the vertical descent path and begins taking high-resolution television pictures plus gamma-ray spectroscopy. At the lowest possible altitude the survivable capsule is slowed by retro-rocket for a rough but safe landing. The main spacecraft is destroyed on impact.

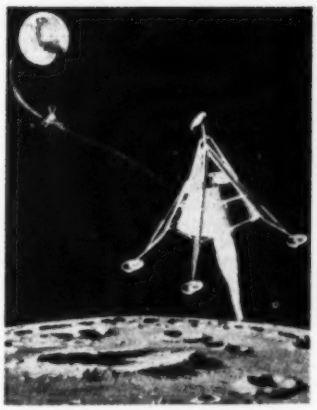
The two spacecraft types just described are well along in development, as are their scientific payloads, with the exception of some of the planetary probe instrumentation. The following section will deal with the spacecraft which are still in the planning stage for the more advanced missions.





Above, Saturn - launched Voyager craft intended for orbit around Mars or Venus, with instrumented capsule for atmospheric study

Left, spacecraft design for Ranger and Mariner series, which is already well ahead in its development



Right, Centaur - launched Surveyor will be designed for soft landing on the Moon

The next spacecraft to be undertaken as part of the lunar and planetary program is Surveyor. It is designed for the lunar soft-landing mission using a Centaur launch vehicle. An artist's conception of this spacecraft is printed in column 2. This spacecraft will be designed to deposit a moderately heavy (100-300lb) scientific payload on the lunar surface, where it would examine the fields, atmosphere, and the surface and subsurface characteristics with a variety of instruments, including television, spectrometer, seismometer and magnetometer.

A conference was held at the Jet Propulsion Laboratory at which 37 companies were invited to submit bids to carry out a spacecraft design study to be completed by the end of this year. Twenty-four proposals were received from which four were selected for paid studies. A contract for the development of hardware should be awarded early next year.

Under the project name Prospector, the lunar soft-landing spacecraft to be launched by Saturn is under study by the Jet Propulsion Laboratory and Marshall Space Flight Center. The Prospector spacecraft is envisaged as a soft-landing "truck" with several alternative payloads such as the mobile vehicle pictured at the foot of the opposite page.

This mobile laboratory would have first priority as a Prospector payload. It would be capable of exploring throughout a radius of perhaps 50 miles, terrain permitting, and would obtain much more data than could be obtained with Centaur-launched stationary spacecraft.

Illustrated at the top of this page, the Voyager project involves Saturn-launched orbital craft for Mars and Venus. The spacecraft would be designed to eject an instrumented capsule for atmospheric entry and perhaps landing. Data from the capsule could be stored and relayed by the parent craft or could perhaps be received directly on Earth.

All these spacecraft, NASA have emphasized, will be no better than the instrumentation which goes into them and the technology on which their performance is based. Adopting the somewhat arbitrary distinction of "environmental" and "observational" instruments, the following will be needed:—

Environmental: (1) Radiation detectors of all types covering all ranges of the energy spectrum and, it is hoped, discriminating between particle types and electromagnetic radiation; (2) micrometeoroid detectors; (3) pressure, temperature and ionization gauges; (4) sound detectors and analysers; and (5) mass spectrometers.

Observational: (1) Television, ranging from microscopic examination of particles to far-scanning of the lunar terrain; (2) radar, to be utilized both on the surface and in orbit to determine not only position but contour of the land and perhaps some of the surface structure; (3) spectrometers of all types, including the X-ray, fluorescent, gamma-ray, and mass varieties; (4) seismometers; (5) magnetometers; (6) penetrometers; (7) chemical analysers; (8) microbiological equipment; and (9) gravimeters.

Preliminary work on many of these instruments has already begun and, as is well known, first-generation instruments have been flown on a number of occasions.

To place the instruments at the exploration site and then obtain the desired data requires many technological developments. These include high-power telemetry; low-noise receivers; improved power supplies of chemical, solar, and nuclear varieties; and advanced computers to be carried aboard the spacecraft. Additional needs include advanced guidance, navigation and control equipment for both the mid-course and terminal phases, and advanced spacecraft propulsion equipment, both chemical and electrical.

In addition, there is a great need for improved lightweight spacecraft structures and packaging. Techniques must be developed for entry and survival in the planetary atmospheres, and equipment must be developed for sample gathering and processing through the scientific instruments. A major problem exists in the development of propulsion techniques for mobile surface exploration vehicles. Environmental control will be difficult and will become increasingly difficult as the payloads become more complicated. Applying to all of these technological areas, and to the instruments as well, is the necessity for improved lifetimes and reliability.

In the 1961 fiscal year, the US Government plans to spend approximately $75m on lunar and planetary exploration programmes, of which some $20m will be for launch vehicles. The remaining $55m will cover spacecraft and payload development and manufacture, of which approximately $35m will be subcontracted to industry and universities. This percentage is expected to increase as time goes on.

NASA's lunar, planetary and interplanetary programme will be executed or directed by the Jet Propulsion Laboratory, under the overall direction of NASA Headquarters. In turn, JPL will rely heavily on contracting to industry for spacecraft, systems, subsystems, components and parts. Universities may be expected to play a major role in the development of scientific experiments, although NASA is inviting further initiative in this from the instrument companies.

Missiles and Spaceflight . . .

COSMIC-RAY RESEARCH AT IMPERIAL COLLEGE

British-built hardware intended for the Anglo-American Scout 1 satellite was shown semi-publicly on December 6 by Prof Harry Elliot of Imperial College, London. Presenting his inaugural lecture as professor of physics at the College's distinctive new physics building in Prince Consort Road, Prof Elliot showed the "engineered prototype" of his team's cosmic-ray detection equipment for the joint satellite, together with similar equipment designed to be carried by the Black Knight rocket.

With the title *Cosmic Rays and the Exploration of Space*, Prof Elliot's lecture described how cosmic rays could be used to provide information on the conditions in interplanetary and interstellar space, and how the IC cosmic-ray research programme fitted into the general picture of activity in this field.

Although Prof Elliot was discussing the scientific exploration of space, and not manned exploration, he mentioned incidentally that storms of high-energy particles produced by solar flares would be "a real hazard" in manned spaceflight. A large amount of shielding would be needed to protect the occupants of a spacecraft, he said, but the more intense the burst of particles the less frequently it was likely to occur.

Primary cosmic-ray particles, which were electrically charged and therefore deflected by magnetic fields, acted as a useful tool for the detection and measurement of these fields in space. The observed influence of the interplanetary magnetic field on the galactic cosmic rays could assist in the formulation and checking of plausible models of this field. Three main models, based respectively on a turbulent field, the so-called solar wind, and a dipole field, had been proposed.

With the launching of Pioneer 5, with a magnetometer aboard, came the opportunity to check by direct measurement which of the three hypotheses was most nearly correct. "The data from Pioneer 5 appear to support the third of the three models," Prof Elliot (who also favours this version) reported, "but unfortunately the apparatus for determining the direction of the magnetic field failed to work and there is some doubt about the exact interpretation of the results. This is a particularly tantalizing situation, but no doubt successful measurement of the interplanetary field will be achieved by this means in the near future."

To increase the precision and sensitivity of cosmic-ray observations, and in particular to reduce the screening by the atmosphere of the very-low-energy rays, high-altitude measurement techniques for aircraft, balloons and satellites had been developed by the Imperial College cosmic-ray group. Prof Elliot showed, and demonstrated in action, a large box-shaped detector designed for use in Canberra aircraft. This was powered by dry batteries and was completely automatic in operation.

SPUTNIK 6 DETAILS

After the unsuccessful attempt to recover from orbit the sixth Russian Earth satellite—third of the 4½-ton "space-ship" satellites—on December 2 (*Flight*, December 9), the following details of its flight were given by the Tass news agency.

Supplementary data had been obtained (the agency stated) on the effect on the organism of animals of various factors arising at the time the sputnik went into orbit and on the behaviour of test animals in the conditions of spaceflight. "The measuring and television equipment has provided scientific information on the functioning of the cardio-vascular and respiratory systems of the test animals and their behaviour while affected by vibration, overload, noise and weightlessness.

"Results obtained after processing the information received from the space-ship satellite show that the dogs endured the orbiting period easily enough and that the activity of their organisms soon returned to normal. . . .

"Supplementary information has been obtained on the reliability of the space-ship's design, the functioning of its individual units and systems and the working of the sources of energy on board. The stable functioning of the radio-telemetering system ensured transmission to the Earth of the necessary information on the functioning of the equipment and on the state of the animals.

"The radio facilities designed for controlling from the Earth the equipment on the space-ship and for controlling the flight orbit functioned smoothly throughout the flight of the space-ship. The television equipment made it possible to observe the condition and behaviour of the animals. The results of the tests transmitted to Earth confirmed that the systems designed to secure subsequently the necessary conditions for the normal life of a human being in flight—air-conditioning, heat regulation, communications etc—functioned very reliably . . ."

"Flight" photograph

Prof Harry Elliot (right) and Mr Alastair Durney, of Imperial College cosmic-ray group, seen during bench-testing of the prototype cosmic-ray sensor for the Scout 1 Anglo-American satellite. Designed by Prof Elliot's group and built by McMichael Radio, the sensor will measure the energy spectrum of primary cosmic rays

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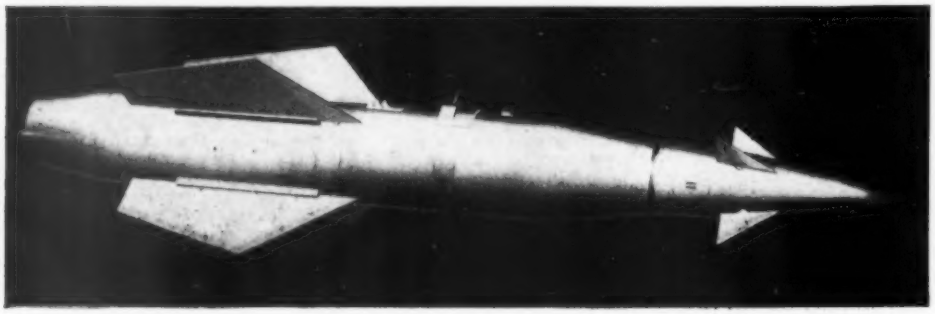
Martin's Orlando Division achieved on December 12 a notable step forward in their development of the Pershing selective-range missile for the US Army. A two-stage test missile flew 140 miles down the Atlantic Missile Range carrying the operational inertial guidance system. It was the eighth success in nine Pershing launchings.

The Air Ministry announced on December 13 that at 2007 GMT on that day a crew from the RAF Bomber Command Thor complex based on North Luffenham, Rutland, made a successful launching from Vandenberg AFB, Cal. It was the sixth Thor to be fired down the Pacific Missile Range in the RAF combat-training launch programme.

Hughes Aircraft and the USAF announced on December 1 that three new contracts recently signed cover production of Falcon missiles during the year ending June 30, 1962. The aggregate value of the contracts is $65m (£23.3m), paying for GAR-11 Nuclear Falcons for F-102s, and GAR-3A (radar) and GAR-4A (IR) Super Falcons for F-106s. This work will hold employment at the Tucson factory steady at about 4,000.

According to Richard Hughes, reporting to the London *Sunday Times* from Tokyo, the Soviet Union has a missile base on the Kamchatka Peninsula the main target-area of which appears to be China. "Japanese intelligence authorities" are said to have photographs showing eight 1,500-mile missiles installed there, as well as "6,000-mile intercontinental" missiles. It is implied that the pictures were taken by the Lockheed U-2s which earlier this year were based at Atsugi AFB.

The capsule of the satellite Discoverer 18, launched from Vandenberg AFB on December 7, was ejected from orbit after 48 revolutions and successfully caught in mid-air as it descended by parachute near Hawaii on December 10. The pilot of the C-119 which caught the capsule on a trapeze-like sling trailed behind the aircraft was Capt Gene Jones, who was also responsible for catching the Discoverer 17 capsule on November 14. The height at which the catch was made was 14,000ft. This was the fourth recovery of a Discoverer capsule in six launchings, and the third successful mid-air catch.



First photograph of GAM-83B Bullpup "B," by Martin's Orlando Division, shows that the same guidance and control section has been applied to a fatter main body housing a larger motor and nuclear warhead. The wings are of greater area and revised profile; and the small removable panel between one pair of control fins (air-bottle filling on GAM-83A) is stencilled "crystal access"

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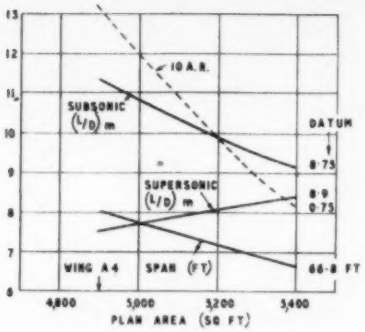

Fig 1. Subsonic and supersonic lift/drag ratios for an aircraft with a total volume of 18,600 cu ft, wing area of 6,000 sq ft and length of 165ft

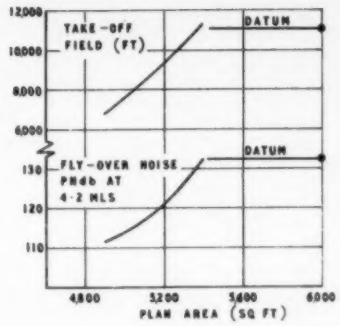

Fig 2. Take-off runway requirements and noise levels at a gross weight of 300,000lb, showing the advantageous effect of increased aspect ratio

SUPERSONIC - TRANSPORT IMPLICATIONS

THREE hundred assorted engineers, pilots and airline operation pundits packed into the Royal Aeronautical Society's new lecture theatre on December 8, to put it to its first major use. The theatre, opened on December 2 by Lord Brabazon, was the scene of a one-day symposium on supersonic transport aircraft with Sir George Gardner and Mr M. B. Morgan as co-chairmen. More than 100 other engineers had to be satisfied with places in two "overflow" rooms, suggesting that if one lecture theatre is better than none, the RAeS could do with even more lecture accommodation than it now has.

IGNORANCE and conflicting theories about sonic "booms" cast their shadows over the whole question of the development of a supersonic airliner. Will the booms caused by supersonic transports at altitude be intolerable to the public beneath? Will legislation be passed restricting supersonic airliners to subsonic speeds when flying over populated areas? Will all the optimistic calculations of the economics of M2 or M3 transports be wrecked by the need to fly overland routes at subsonic speeds, or make lengthy detours around coasts? Or has the problem of sonic bangs been exaggerated? Is there, in fact, any real problem at all?

The most obvious conclusion to be derived from the all-day discussion about supersonic transport aircraft held in the Royal Aeronautical Society's new lecture theatre on December 8 was that designers and operators alike would give their metaphorical right hands to know the answers to these questions. So lightly shrugged off only a few months ago, the shock-wave question is now evidently causing furrowed brows in design offices and the haunts of operational planners.

Time after time speakers came back to it and indicated that until more is known about it, little practical work on a supersonic transport can be done. Indeed, one airline speaker implied that airlines were unable to make any economic calculations whatsoever until they knew whether supersonic aircraft would be allowed to cruise supersonically only when over the sea, or over land as well. He gave the impression that his airline would not be interested in an aircraft prohibited from cruising at its optimum speed over large portions of its routes.

Aerodynamics

The assistant chief engineer of Bristol Aircraft, Mr M. G. Wilde, opened the discussion with a paper on aerodynamics. Mr Wilde took as his starting-point two previous papers, one presented before the Society in March by Mr M. B. Morgan, which concluded that a M2 aircraft would prove a natural "fit" for the first generation of supersonic transports, and that read by Dr D. Kuchemann before the International Congress of Aviation Sciences in September.

Kuchemann concluded that a slender delta wing provides the natural basis for the layout of a supersonic transport, making certain assumptions about the variations in supersonic drag with changes in geometry. Mr Wilde made the same assumptions but considered, too, the effect that geometrical changes would have on the "off-design" flight conditions.

Kuchemann found that the best lift/drag ratio that could be achieved at M2 with this plan-form configuration would be 8.9, occurring at a semi-span/length ratio of 0.202. He predicated an aircraft with a total volume of 18,600 cu ft, a wing area of 6,000 sq ft and of 0.75 aspect ratio (Fig 1). With the optimum semi-span/length ratio for cruising economy, the fuselage would be 165ft long, seating 100 tourist-class passengers. The fuselage would have a total volume of 8,600 cu ft, while the remaining wing volume would be adequate to hold the 158,000lb of fuel required for the North Atlantic crossing. Such an aircraft would have a take-off weight of about 300,000lb.

An important factor in Kuchemann's calculations of drag coefficient was expressed as p—the ratio between the plan area and the circumscribed rectangle. This ratio in Kuchemann's datum aircraft was 0.542. Its value was progressively reduced in the four variations from the datum aircraft examined by Mr Wilde. The zero lift drag rose fairly rapidly as p was reduced, since with the fixed fuselage dimension the wing filled less of the total plan-form area and the drag more nearly approached that of the fuselage alone.

Progressive reductions in p produced four effects. At M2 the maximum lift/drag ratio decreased, for the semi-span/length ratio was increased beyond the optimum of 0.202. It was assumed that the aircraft would be cruised at a fixed percentage of the lift/drag ratio so this would lead directly to an increase in the cruise fuel. In the datum aircraft, 51 per cent of the total fuel would be used in the cruise regime, the remainder being burned in take-off, climb, descent and landing and carried as reserve.

Since it was assumed that the cruise conditions would dictate engine size, the powerplant weight would increase, but this would be offset by the third effect, a reduction in the structure weight through reduction in wing area. The off-design fuel (49 per cent in the datum aircraft) could also be reduced, owing to the reduction in subsonic vortex drag which the increasing aspect ratio would confer.

Variations

The same take-off weight of 300,000lb was retained in the four variations studied by Mr Wilde. As the wing area was progressively reduced and the span increased, the maximum supersonic lift/drag ratio decreased from 8.9 to 7.48 in the lowest case. In the subsonic regime, the ratio increased from 8.75 for the datum aeroplane to 11.35 for variant 4, an aircraft with a wing area of 4,900 sq ft, a semi-span of 40ft and an aspect ratio of 1.305. The effect of this on the fuel carried was seen in the progressive increase in the amount of cruise fuel needed and a compensating decrease in the off-design fuel.

Mr Wilde then compared the flight characteristics of these compromise aircraft. None of the wings considered stalled in the accepted sense, so the stalling and approach speeds would be governed by other considerations—not least those of pilot visibility and passenger comfort. Defining the minimum flying speed as that at 18° incidence above the zero-lift condition in free air, and the approach speed as 25 per cent above the minimum flying speed, the speaker calculated the approach speed of the 6,000 sq ft datum aircraft as 156kt and that of the 4,900 sq ft variant as only 140kt. This approach speed would be attained at an attitude of about 12° over zero-lift, or on the normal 3° glide-path at an inclination of 9°.

The advantages of the higher-aspect-ratio, smaller-wing-area designs on the approach would be no less noticeable at take-off. Take-off distance decreased from about 11,100ft for the datum aircraft of 0.75 aspect ratio to only 6,800ft for the 1.305 aspect ratio variant. Fly-over noise nuisance was correspondingly reduced, for height at 4.2 miles from take-off was increased from 630ft to 2,635ft and the noise at ground level fell from 132.5PNdb to 111.5PNdb accordingly (Fig 2).

Mr Wilde concluded that the datum aircraft predicated in Kuchemann's paper, though having the best possible lift/drag ratio when cruising, would have poor low-speed flight characteristics. Other layouts were available which achieved comparable economic results with greatly improved off-design flight characteristics. These compromise aircraft with reduced wing area and increased aspect ratio would have wing and fuselage as more distinguishable features of the design. This would increase the aerodynamicists' worries as there would be more complex flow conditions with substantial interference effects. The aerodynamicists' primary task would be to ensure that these interference effects between wing and fuselage were arranged in the way most favourable to the cruising regime.

Immediately Mr Wilde had finished, Capt Jackson of BOAC was on his feet to ask about the pilots' view on the approach. The speaker thought that at the inclination of about 10° to the horizontal it would be possible to get a "reasonable view" but it would probably call for some variable geometry at the nose. Capt Kane of BOAC then made the first of a number of pertinent interjections when he asked what the aerodynamicists considered a "reasonable view." There would be a very good view forward

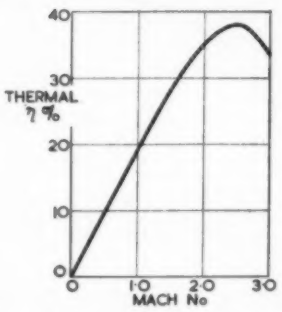

Fig 3. Overall thermal efficiency of a non-reheat turbojet with convergent/divergent nozzle

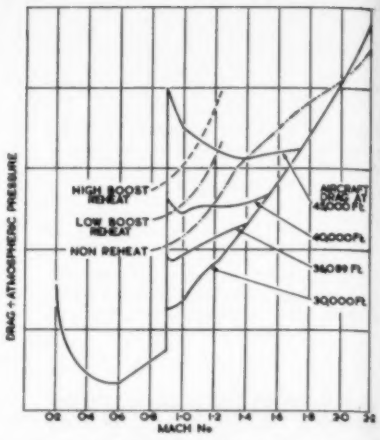

Fig 4. Drag divided by atmospheric pressure, and thrust, of supersonic aircraft plotted against Mach number throughout the transonic regime

along the sides, replied Mr Wilde, due to the slender nose. Mock-ups of proposed nose configurations would soon be available for BOAC's inspection.

Answering further questions, Mr Wilde (who as a member of BAC's engineering staff can be safely assumed to be working on the supersonic transport study recently commissioned by the MoA), said that a variable geometry wing would certainly improve low speed characteristics, but would incur very heavy weight penalties. He thought, however, that such a wing would be essential for cruising speeds exceeding M2. The fixed geometry compromises he had discussed would have favourable effects on the transonic acceleration phase of flight: the aircraft would either take less time to get through it or be able to get through at a lower altitude. The reductions in wing area would have negligible effects on the optimum cruising altitude and there was less than two per cent variation in seat/mile costs over all the five configurations studied.

Propulsion

The name of Mr H. Pearson, chief engineer (performance and research) at Rolls-Royce is synonymous with wit at aeronautical discussions and he did not disappoint the audience when he spoke on propulsion problems. He started on a most confident note.

"In the question of propulsion of aircraft at Mach 2 and beyond the efficiency of the powerplant is no problem," he said. "Due to the high pressure developed from the intake the engine's overall pressure ratio is high and the aircraft forward speed being high, the Froude propulsive efficiency is also favourable. At Mach 2 overall thermal efficiency was as high as 35 per cent" (Fig. 3).

Falling aerodynamic efficiency was offset by rising propulsive efficiency. This point had been obscured in certain quarters. Engine specific fuel consumption on a thrust basis, normally the one considered for turbojet engines, did not have a good value at M2, being about 40 per cent higher than for subsonic aircraft, but the genuine consumption, that based on the useful power developed, was actually far superior.

The highest engine temperatures possible were desirable, to give the maximum amount of thrust for a given frontal area and low specific engine weight, both vitally important. Current thinking about supersonic engines for use in ten years' time assumed a cruising temperature of about 1,350° Kelvin—equal to the highest temperatures being employed for take-off today. Materials would have to sustain for long periods temperatures encountered only for short periods so far. Turbine blade alloys would have to perform at some 100°C higher than those used now.

This was a problem for metallurgists. It seemed that nickel-base vacuum cast alloys would have the needed superiority over today's nickel-base wrought vacuum melted alloys.

Blade cooling by air tapped from the compressor would be hindered by the fact that the tapped air would already be rather hot. Similarly, the cooling of bearings, normally done today with air tapped from a low-pressure stage of the engine, could probably be done by this means at M2.2, with air at about 220°C.

At high Mach numbers the air intake became a critical part of the engine, for the pressure ratio derived from it was rather greater than that derived from the compressor. The problem would be the correct matching of the intake and the engine demand over a wide range of flight conditions. Using a fixed intake, considerable spillage of air would take place at design speed, creating high spillage drag in the cruise, if the intake was to pass enough air at low flight speeds.

The reverse applied if a variable wedge intake was used. If its wedge angle could be varied to give good intake pressure recovery over a wide speed range and its critical flow was matched to the cruise conditions, there would be an excess of air at lower Mach numbers which would create spillage drag. The control of the intake and engine would require major development effort.

The rear end of the powerplant, the nozzle, would be no less critical a design problem, particularly in the transonic range, and Mr Pearson could not claim that a satisfactory solution had yet been found. In principle, a convergent-divergent nozzle was required in the cruise for an expansion ratio of about 12 : 1. At lower speeds and at take-off, a pressure ratio of about 2.5 would be all that was available and for this a convergent-divergent nozzle would cause large losses and probably become unstable, exerting fluctuating loads on the engine.

A variable nozzle was required, therefore, but all proposals examined tended to give large losses of thrust or equivalent increases in drag in the low sonic speed range. This was because in the design condition the expanding gases occupied a much larger rear end area than at take-off and low Mach numbers.

The altitude at which transition from subsonic to supersonic flight would be made would be one of the most critical factors affecting design. It would be governed largely by the ground level intensity of the sonic boom produced. The higher the transition altitude, the greater would be the drag of the aircraft and the lower the engine thrust (Fig 4).

Current thinking about transition altitude assumed a level of 40,000ft and this meant that engine size would be dictated by this flight condition and heavy weight penalties imposed. The alternative was some form of reheat, which would complicate the engine and its installation. Mr Pearson thought that transition with a non-reheated engine would not be achieved above 36,000ft, and if 45,000ft transition altitude was dictated by the sonic boom problem, then a very large engine with great economic penalties would be required.

The speaker concluded with comments on noise, about which he was more optimistic. For landing it might be possible to "choke" the engine with the variable intake and largely prevent compressor noise escaping. Jet noise escaping through the nozzle was not very significant in the landing regime.

The high installed power on a supersonic aircraft would lead to high noise levels on the airport before take-off, and although it might be thought that the aircraft would climb sufficiently rapidly to avoid seriously inconveniencing adjacent communities, the climbing angle would be dictated by the lift/drag ratio, which would be rather poor with the supersonic shape chosen. He thought that the noise level over the airport would be about equal to the quietest present-day subsonic jets—he cited the Conway 707—at about 120PNdb and the airfield noise itself would be about 3PNdb higher. This assumed that no silencers would be fitted as it is difficult to envisage these fitted to variable supersonic nozzles without unacceptable losses in efficiency.

Commercial impartiality was assured in the propulsion discussion when Mr A. V. N. Reed, deputy chief project engineer of Bristol Siddeley Engines, took the stand after Mr Pearson. He analysed the relative advantages for a M2.2 aircraft of turbojet and ducted-fan engines and suggested that the best possible powerplant would be a high compression ratio, high turbine-entry-temperature turbojet. A ducted fan would appear to be desirable on the grounds of reducing noise levels, but it would involve considerable economic penalties and so both aircraft and engine manufacturers had devoted attention to reducing the noise of pure turbojets. He suggested that by the use of variable nozzles, together with particular take-off and climb techniques, noise at ground level 4.2 miles from take-off could be reduced to about 100PNdb.

Mr Reed showed a table which suggested that for equal payload the ducted-fan powered aircraft would weigh on take-off 104.2 per cent that of the pure jet powered machine. Its improved consumption in the cruising condition would be nullified by the larger aircraft to be propelled, and the extra weight of the engine would permit proportionately less fuel to be carried.

In a table of direct operating costs, Mr Reed suggested that the fuel costs of the ducted fan would only be marginally less than that of turbojet—30 per cent compared with 30.5 per cent. This saving was more than eliminated by the higher engine overhaul costs, 14 per cent against 12.8 per cent.

It would be important, from the point of view of the public who would suffer from booms, to fly the transonic acceleration phase as high as possible. He agreed with Mr Pearson about reheat, which could be installed with both turbojet and ducted-fan engines, but thought that there would be a difference of 8,000ft in the transonic acceleration altitude capability of similar aircraft with turbojets and ducted-fan engines, with the turbojet-powered machine accelerating at the higher level. R. R. R.

(To be concluded)

FLIGHT, 23 December 1960

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EPIC AIR-GIRL SERIES—*NON STOP SOLO ACROSS THE MIGHTY SOUTH DOWNS*

BY ROMA MAÑANA

LOVE at first flight

Someone, somewhere, would press a button. Intercontinental ballistic missiles with thermonuclear warheads would rise from the launch pads and streak through the Surrey sky. Was Jeremy's interior-decorating business to receive yet another annoying setback?

THE STORY SO FAR:

Jean Lovebounty, attractive computer programmer at the Ministry of Aviation's top-secret missile base in rural Peckham, is in love with Dr Gregory Wayne-Eloquent, handsome senior scientist at the base. Captain Elthwick Smoothly-Graunch, handsome airline pilot who is resting between engagements, tries to persuade Mary to leave Peckham and move to his country seat in Aberystwyth, but they are interrupted by a knock at the door. They open the door, whereupon a body falls in and lies dead on the cerise carpet. It is Elthwick's brother Simon who, unknown to the Minister, was in league with the mysterious Group Five, whose initial attempt to obtain the secret of Dr Wayne-Eloquent's work on the new missile-label stencil marker was foiled by Janet, attractive sister of handsome Horace Ablestar, proprietor of the nearby Kountdown Kafe. After Aathea's riding accident Janet's attractive friend Elspeth Merrydown falls in love with handsome young laboratory assistant Jimmy Notworthy, but not before Jimmy has been p'aced under suspicion by means of an anonymous letter written by old Mrs Runcible, who is believed to be a harmless eccentric but who in fact is the brains behind Group Five. Meanwhile, handsome Roger Effortless-Base manages to escape, but is then trapped by the strange monster which crept out of the Basingstoke Canal the day after the mysterious flying saucer landed at Woking. Emily is mistaken for the monster but refuses the "Daily Bind" offer of £5,000 for her story. This story, together with a cutaway drawing of a five-amp goofle-switch detector-element storage-rack mounting pin trolley which originally appeared in "The Goofle-Switch Detector Element Storage Rack Mounting Pin Tro'ley and Astronautics," has been stolen from Sir John's chauffeur by an unsuccessful but handsome air traffic controller named Jeremy Otherness, whose gifted, attractive sister Veronica has just failed her Private Pilots Licence examination for the eighteenth time. Paulette does not realise that anything is the matter until Roger drives up purposefully in his Jaguar. At Baginton, all is quiet on the main runway. Nevertheless Edith is worried about Henry . . .

NOW READ ON

JEAN walked pensively across the verdant campus of the Peckham research base towards the laboratories. She had just left the offices of the director, and she was worried. Someone had stolen the secret agenda for the magnetohydrodynamics symposium, and suspicion had fallen on Gregory.

Gregory, she mused. Even now the very name seemed to set her heart racing like a wild thing. Gregory, with his brilliant mind, his baggy trousers and well-patched jacket, his rumpled smile and his battered old pipe. His shelves full of technical papers and learned society journals. Him and his pet hippopotamus. Silly, crazy, wonderful man.

Not that Gregory was just a stuffy intellectual. Jean uttered a short laugh at the thought. Why, hadn't he been the first to paint that policeman green the night of the lab party? And how about his two-stage go-kart, with pillion seat just for her?

But her thought came back again to the symposium. Who could have been mean enough to steal the draft agenda? And would it, could it possibly affect Gregory's chances of promotion?

Promotion, she mused. Even now the very word seemed to set her heart racing like a wild thing. Perhaps, with promotion might come wedding bells.

Her thoughts were interrupted by the sound of breaking glass. She turned and looked back across the entrance lobby of the laboratory block.

"Who walked through that window?" she asked.

"Why, you did, Miss Love-

please turn to page 977

My Business Bird-man

FLIGHTESS flies to America for this week's interview in our "Flying Husbands" series. It's almost all work and no play for the husband of attractive Mrs Otis X. Rosewheeler III, but, as she reveals to YOU in this exclusive heart-to-heart, woman-to-woman chat, life has its golden moments, too. Why not send us the story of YOUR flying husband?

WELL, I guess my husband's just about a typical kinda business flyer. Sure finds flyin' helps him a whole lot, businesswise. Y'see, he's a physiotherapeutic appliance salesman, and I just don't know how he'd get to attend the National Flying Physiotherapeutic Appliance Salesmen's Annual Fly-In Meet if he didn't have his airplane.

Then there's the Airplane Renter and Flyers Association's Plantation Party down in Florida, after that there's the National Business Flyers Semi-annual Convention and Physio-space Panorama up in California, then of course he daren't miss the National Physiotherapeutic Appliance Fly'n' Buy Meet out at Mexico City.

Every month they hold a regional Flying Physiotherapeutic Appliance Salesman's Monthly Air-wares Jamboree, not forgetting the State-by-State Tourin' Round-up Assemblage and Bar-B-Q organized by local branches of the Keep Physiotherapeutic Appliances Flying Association Inc.

Then on the social side there's the bi-weekly Fish Fry 'n' Clambake Party across in Bermuda, sponsored by the Flying Salesmen's Guild, Physiotherapeutic Appliance Section; while on alternate months we usually head for the Cockpit Corall 'n' Bar Ranch Rodeo out in Arizona. Just forget who organizes that one but, like I said, guess my husband's just about a typical kinda business flyer.

Pardon me? Oh, you mean fly on jobs? For heaven's sake, no. He works at home.

★★★

Style . . .
Fashion . . .
Elegance . . .

Drogue

FASHION PAGE

Next year's fashions, Drogue can reveal, will be gay, vibrant, and sparkling. Intense, shimmering tones of cerise red, burnt orange and glowing topaz vie with the softer, calmer moods of coffee beige and rich heliotrope. Multi-layered sweater outfits provide warmth, answering fashionwise instructor's question "Why don't you wrap up?" Drogue's colour-of-the-year is exciting amber. Mohair and aluminized jersey are the fabrics to watch, their feathery softness rivalled only by the delicate subtlety of the evening brocades and satins.

And what of your 1961 silhouette? Waistlines will be high, necklines will be low. Collars will be wide and low, hemlines will be narrow and high. The beetle-back effect is in, jackets will be tight, and hats will be lowered to one inch below the eyes. The general effect? Singularly uncomfortable.

Most important feature of next year's fashions is here revealed exclusively by Drogue. Smart women everywhere will wear—CLOTHES! We confidently forecast that *clothes* will be worn by everyone in fashion next year. Try *clothes* for that well-dressed look.

Dazzling aluminium-alloy is the fashionable fabric for next year's missiles. Nosecones are blunt, and sheer white is employed dramatically as the predominant shade for pre-countdown gaiety and sparkle. The models, incidentally, are wearing clothes

Charming two-piece winter flying kit (above left) is modelled by typical girl flyer at Lasham Gliding Centre's No 3 swimming pool. Above right, girl technician displays latest laboratory working dress and examines Bloodhound missile intently

Note elegant styling of 1961 hats for after-dinner wear (just before photograph was taken, mighty Hovercraft flew under bridge)

LOVE AT FIRST FLIGHT . . .
(from page 974)

bounty," answered the receptionist with a smile.

"Oh, well," replied Jean with a gay laugh that tinkled pleasantly down the corridors, "maybe it's my lucky break."

Quickly she went to her office, packed her weekend case, and thought how nice it would be to see Elthwick at the quaint little aerodrome where he kept his own aircraft, that fast little type with the most exciting lines. "How nice to see Elthwick at the quaint little aerodrome where he keeps his own aircraft," she repeated aloud, "that fast little type with the most exciting lines."

"—Somebody called?" enquired a quiet voice at her side. "Oh, Janet, don't be silly." Jean answered with an embarrassed start.

"Seen much of your two boy friends lately?" Janet persisted, "I thought they were very, you know, friendly to me that night you were kept working late last week. And they were talking about some daft agenda or something."

The blood drained from Jean's face. "I, —er, I think I have a bus to catch," she muttered, slamming the door in Janet's face and running down the corridor and out through the entrance lobby. The sound of breaking glass followed her across the campus.

* * *

In the glittering all-chrome offices of the *Daily Bind* the night news editor pushed his green eyeshade back and dunked his cigar in the half-pint of whisky at his side. "What's that?" he yelled into one of his nine telephones, "Draft Agenda of Secret Symposium? Go ahead. Print it."

At the next desk, one of the sharp-eyed newsmen glanced up sharply. He consulted a small book written in Russian, took another swig from the half-pint of gin at his side, and strolled casually over to the night editor.

"Want a follow-up on the Symposium piece, boss?" he asked.

"Yes, old boy. And make it good. Get hold of the girl. Make her talk. Interview her other boy friends. What does her family think? Is she ashamed of it all? Did they really—"

"What girl, boss?" enquired the newsman.

"Don't bother me with details. Get out on the job," snarled the night editor, taking another gulp of whisky.

* * *

At the airfield, Jean struck a match on the petrol bowser and lit a cigarette as she waited for Elthwick. He was often late these days, she thought.

But what did it matter, so long as they were together. Together, their hearts singing with the joy known only to those for whom the sky was home. All else was unimportant.

"Well, hello there, sweetie, how's every little thing?"—the words burst in on her thoughts and sent her heartbeat rocketing to the sky. "Elthwick!" she exclaimed rapturously, "You're here at last."

"Not exactly," replied the tall, moustached man in flying kit. "Elthwick couldn't make it. My name is Harold."

*

"But what's happened to Elthwick?" Jean demanded. "He isn't —he hasn't—he can't be—it just isn't possible for him to have—you don't mean — there wasn't a — or did the—?" Her voice choked away to silence, bubbling under a flood of tears.

"No," replied Harold. "Come for a stroll and I'll tell you all about it."

Hand-in-hand, they strolled along the pleasantly paved main runway, not even noticing the pilots and passengers who waved to them in friendly fashion as the various aircraft zoomed down to earth, roared off into the sky, or finished in a crumpled mass of wreckage after swerving past Jean and Harold and colliding with the control tower.

WHO is the mysterious Harold?
WHY couldn't Elthwick make it?
WHERE is the Draft Agenda?
WHAT did Janet mean by "very friendly"?

Do not miss next week's gripping instalment of LOVE AT FIRST FLIGHT.

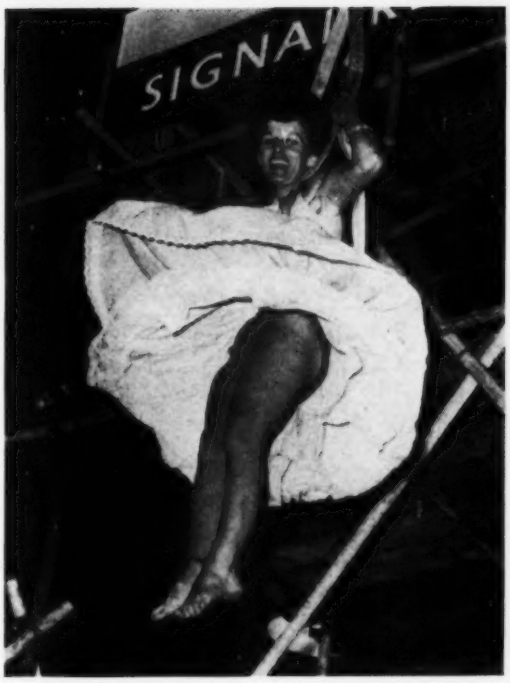
CONTROL COLUMN . . .
(from page 977)

what was the matter, so I went to see my doctor. I told him what the trouble was, that I felt fine but couldn't help worrying why I wasn't tired and fatigued and weary every morning.

He suggested I might be taking too much of these bedtime milk drinks, and said why didn't I try giving them up for a while. And so, every night, I tried no bedtime milk drink!

Only a week later, I was able to report I felt really awful again. I was so glad. The boss said we'd managed to fool the tax man again, thanks to me. Thanks to no bedtime milk drink, he should have said. And then there was that funny business of

please turn to page 977



New 1961 lightweight parachute design is displayed here in action by typical British girl parachutist. Going up or going down, I read "Flightess" every week, she says. New-style waist-level parachute has many advantages over quaint old-fashioned over-the-head type, according to experts, although they admit the old chutes kept the rain off during descent. "Using the new chute there seems no shortage of male helpers on landing," our airgirl confided with a smile

Check your Air-score HERE ▼

- **More than ten As:** *You have confidence, talent and intelligence. You are psychologically unfit to fly, even with that handsome CFI. Why not write to Plane Jane about it?*
- **More than five Bs:** *You are sensitive, artistic and have a marked flair for colour. None of these is required in flying. Consult Plane Jane immediately.*
- **Less than one C:** *You are the aggressive type, slightly clumsy but well-meaning and kind to animals. None of the many accidents you have had were really your fault. Your memory is not very good, you hate people, and your eyesight is failing fast. Welcome to the ever-growing band of typical private pilots.*

I Fought With the Maquis

English Girl's Story of Wartime Courage and Adventure

YES, I fought with the Maquis. And could those Frenchmen fight! It took me all my time to keep those boys at a safe distance, I can tell you.

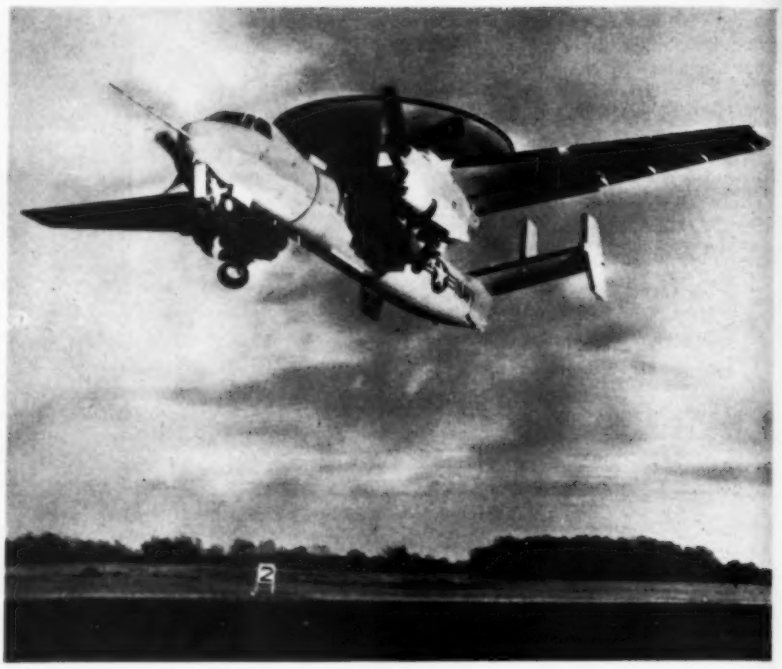
My most exciting adventure began as I was brewing a pot of tea before one of their raids on an enemy-held railway station. One of the gang had always been a bit familiar, but believe you me he went a bit too far that night.

I was in my room waiting for the kettle to boil when Henri suddenly climbed in through the window. "Now, look here, Henry," I said firmly, "I've told you before about coming in here without knocking and pretending you didn't realize that this wasn't the billiards

(continued on page 977)

Grumman Galaxy

SOME NEW SHAPES FROM LONG ISLAND



Take-off of the first W2F Hawkeye, revealing the unusual retraction of the main gear

UNTIL recently the Grumman Aircraft & Engineering Corp was synonymous with carrier-based fighters for the US Navy; and not without good reason, for there was a time when the plant at Bethpage, Long Island, made such aircraft at the rate of 6,000 annually. Today Grumman present an entirely different face to the world; and in some respects it is one that is unique. In addition, so to speak, to having fingers in several pies which are not even aeronautical, they have one foot firmly in the door leading to space and yet have broadened the basis of the traditional side of their business in a manner which runs contrary to the supposed trend regarding manned aircraft.

On these pages are illustrated the Orbiting Astronomical Observatory referred to in recent issues, together with four current Grumman aeroplanes. The diversity of the latter is astonishing, and the company's versatility would be further emphasized had we included pictures of the supersonic Tiger, the Ag-Cat biplane for farm use, the Tracker series of ASW machines and the sleek Gulfstream business transport. No other company in the world makes such a welter of utterly dissimilar aeroplanes.

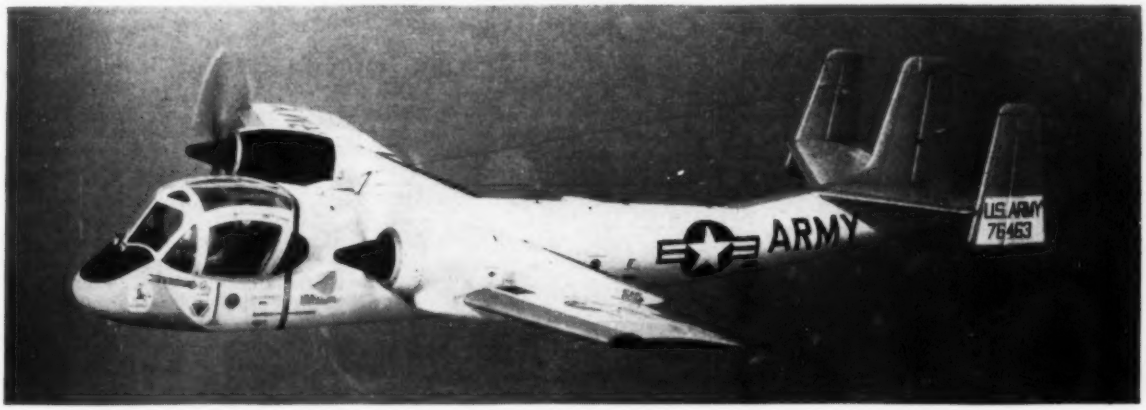
Above and above-right are excellent studies of the W2F-1 Hawkeye early-warning machine for naval task forces. After submitting their design to the US Navy in May 1956, Grumman were given the prime contract for the W2F on March 5, 1957, and flew the first to be completed on October 21 of this year. The Hawkeye is powered by two 4,050 e.h.p. Allison T56-8 turboprops and carries a crew of five in its pressurized fuselage. Within the retractable "rotodome" is housed the aerial for powerful, high-resolution radar, which at 25,000ft is capable of covering an enormous volume of sky. Its output is passed to airborne computers, a memory and a rapid data-link system, in order to identify, track and evaluate targets and be capable of directly commanding interception forces.

Below is a new photograph of the A2F-1 Intruder carrier-based attack machine. Of uncommon technical interest, the Intruder is powered by twin Pratt & Whitney J52 engines with swivelling jetpipes, and it aspires to the same degree of structural and "systems" sophistication as our own Buccaneer. Equally unconventional is the US Army's AO-1 Mohawk (right). Officially described as a high-performance observation aircraft, it is powered by a pair of 1,000 e.h.p. Lycoming turboprops and, although carrying a crew of two and an extraordinary array of surveillance equipment, can clear a 50ft obstacle in 800ft from brakes-off and can cruise at over 200kt for six hours.

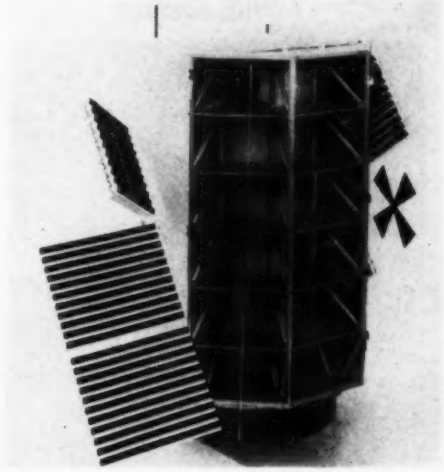
Since it has yet to fly, the last aircraft type is illustrated by an artist's impression. Under the terms of a $1,648,000 Military Assistance Program contract, Grumman are modifying SA-16 Albatross amphibians for use in the ASW role. Powered by 1,525 h.p. Wright R-1820-76 engines, the anti-submarine version will carry radar detection gear, sonobuoys, a MAD boom and ECM equipment. In addition to this detection system, it will be able to operate in the killer role, carrying depth bombs, torpedoes and rockets. The Albatross is in service with ten nations, but those which intend to implement this modification have not been named.

The A2F Intruder seats pilot and navigator side-by-side and can carry five 2,000lb stores externally. The J52-6 jetpipes are canted downwards 7° and can be tilted down through a further 23°; close behind the jet nozzles are perforated stainless-steel airbrakes

Named after a legendary American scout, the 8,100 h.p. Hawkeye "can fly higher, faster, and for longer duration than any other carrier-based AEW aircraft." Grumman have not found it easy to keep within the limitation of carrier stowage, and to keep the height down the rotodome retracts and the aircraft has four fins. Overall height is actually just under 16ft, and gross weight 49,500lb



Above is a pleasing portrait of the AO-1 Mohawk turboprop STOL observation aircraft. Below is an artist's impression of the ASW version of the Albatross, and a model of the Orbiting Astronomical Observatory which will radio cosmic information to Earth



Straight and Level

AS you may recall, I am one of the growing number of people who no longer send Christmas cards to business friends. Nevertheless, I somehow have to acknowledge the thousands of cards that have poured in with every post. To the majority of my well-wishers I have sent a card which says that I am not sending cards this year. This is quite a simple affair, with a seasonal message of greeting inside and, on the cover, a coloured reproduction of robins, holly, yuletide logs, mistletoe, reindeer and jingle bells.

To those who did not receive this simple acknowledgment of their kindness, and to all my readers regardless, I offer the sincere greeting:

A merry Christmas and a happy and prosperous New Year to you all.

● From some of my readers come special messages, all sent quite spontaneously. I have to assure you of this, because some of you may think that the messages which follow were ghosted by my public relations officer and by the p.r.o.s of the people concerned.

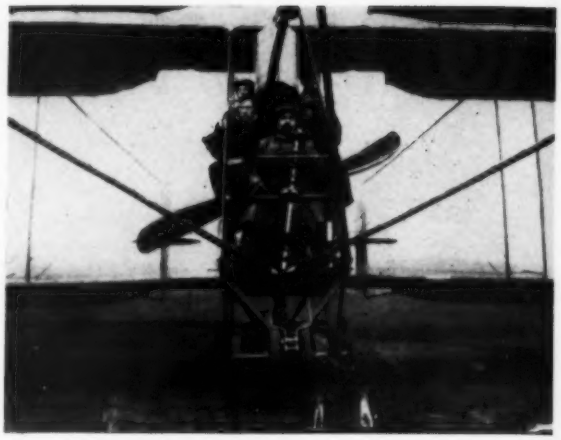
Well, this may be the season of ghosts, and ghost-writers are of course *always* in season. BUT I must ask you to believe that no such cheap deception would ever be practised by R. Bacon. You know that. All these messages were actually penned in the original hand of the people concerned, and I couldn't have written them better myself.

Here goes then, just as they come off the pile:—

● MR HUGH STRANGEWAYS, *Minister of Planes:*—

"My press department was delighted to be asked by your press department whether I would care to sign a message to readers of Straight and Level. A full and frank exchange of views is taking place on this matter, and I am happy to be able to assure your readers that the question will be most carefully considered and kept under active review by my Department. Meanwhile, I do not rule out the problems that lie ahead."

Christmas is a time for story telling, so how about this contemporary caption by Colonel S. F. Cody: "There was I, with my load of high-density low-fare passengers, all set for the Skycoach service to Nairobi when *whoosh*, we were rapidly overtaken by a Boeing 707 with 138 passengers on board. But we'll be all right — we're in pool with BOAC . . ."



● DR J. NIT, *British air expert:*—

"The Jet Age is upon us, and I for one do not doubt that the supersonic age will come. Of course it will come. We cannot stop technologological progress. Moreover, aviation is here to stay, I am convinced. Quite convinced.

"Not only this, but the British aircraft industry is here today. Where it will be tomorrow depends on the outcome of my present researches, to MoP contract, into this very question."

● SIR CHARLES BOOST, *chairman of Plummet Air Lines:*—

"An absolutely super Yankee-smashing supersonic afterburning plasma jet rocket seasonal greeting to you all, and may Britain's record-breaking Blue Riband wonder planes continue to show the flag and enhance the prestige per ton-mile of our Imperial air communications throughout the New Year, eh?"

● HAMISH HAUT-MODE, *Straight and Level's chief fashion designer:*—

"I especially wish to wish BEA a prosperous New Year. It will be a tough fight, even with such charming and attractive stewardesses. But *oh*, those *uniforms* . . ."

● SIR JOHN BLACKOUT-JONES, *chairman, Super Scruggsdyne Grouponics:*—

"My greetings to you all. To all those critics of the British aircraft industry I will just say this: aircraft designing and manufacturing is a difficult business, a difficult business. People just do not fully appreciate how difficult it is. If they did they would understand why delivery dates so often fall behind. Scruggs are never late on delivery, of course. The reason for this is that we do not have target dates. We consider them to be rather vulgar and American. Anyway, a happy Easter to you all."

● MR FRED NITPICKER, *president of the Aviation Bores' Society:*—

"I well remember one Christmas Day many years ago, on December 24, 1903, going for a flight in a Farman Goliath piloted by dear old Boostie, Lt Boost as he then was. The serial number of the aircraft was 900462, construction number 1438, and it was fitted with tailskid Mk 4A/2—though this point is a matter of controversy—some point out that it was a Mk 4A/3. Anyway, it was a splendid occasion, and I well remember drone drone z-z-z-z-z drone drone . . ."

● MR J. FRUITBY, *British aviation S-Man*:*—

"No comment."

ROGER BACON

"Darn it, what are all these cars doing on the runway? It's hard enough to watch out for other airplanes, never mind this kind of traffic. Anyone would think I'd landed on the Los Angeles Golden State Freeway, or something"

* *Secrecy Man.*

A fine example of the ever-young Douglas DC-3—Silver City Airways' aircraft recently converted for overseas radio-aid calibration work for the Ministry of Aviation

Miles Flown, 7,000 million: Passengers Carried, 600 million: A Birthday Tribute to the Most Successful Transport Aeroplane Ever Built

BY PETER W. BROOKS, BSc, ACGI, AFRAeS

THE DC-3 IS TWENTY-FIVE

THOUGH there is some controversy as to when the first DC-3 made its maiden flight a quarter of a century ago, we believe that the date most generally accepted is that quoted by the author—December 22, 1935. Some authorities hold that it first flew on December 18, 1935, but probably that was the day on which it was rolled out. The Douglas company itself confirms the date of December 22. The writer—fleet planning manager of BEA and air transport historian—here tells the story of the world's most famous transport aircraft.

NO transport aeroplane has a history even remotely comparable with that of the DC-3, which made its first flight on December 22 twenty-five years ago. Built in larger numbers—more than 13,000—than any other transport, in production for ten years, in first-line use for nearly a quarter of a century and still, at the end of that period, in airline service in far larger numbers than any other type of airliner, the DC-3 has the proud record of having played the primary role in converting the airlines from an uneconomic, uncertain, new and rather adventurous method of travel into a great and profitable world-wide industry which has already become the most important means of long-distance passenger transport.

There is no simple explanation of the DC-3's phenomenal success. Although it cannot be denied that the Second World War created a demand for a robust general-purpose transport aeroplane which the DC-3 happened to be available to satisfy in the enormous numbers required, there is no question that it had already established itself as a uniquely successful piece of airline equipment well before the war came along to transform its destiny.

The DC-3 was the first aeroplane to combine a robust and durable all-metal structure of clean and efficient aerodynamic design with a spacious and effectively soundproofed cabin and a capacity for between 20 and 30 passengers—sufficient to give a cost per seat-mile which would equate with fares which the travelling public was prepared to pay. The durability of the structure is a feature which has made a major contribution to the type's success: quite a number of pre-war DC-3s are still in active airline service and at least two—still in service today with North Central Airlines—are reported to have reached the colossal total of over 70,000 hours of flying each—equivalent to eight years continuously in the air and an average utilization of 3,300 hours per annum for more than 21 years! Needless to say, this is a considerably higher figure than has been reached by any other design. Most modern aircraft, with their (usually) much more highly-stressed components, are normally designed for lives only about half as long as this, and in practice often require considerable modification and/or rebuilding to achieve even that much lower target.

The story of the DC-3 really goes back to 1932, when the management of the newly-formed United States domestic airline TWA—then Transcontinental and Western Air Inc, later to become the Trans World Airlines of today—which was operating tri-motor Fokkers and Fords, began to worry about the likely competitive effect on its services of the Boeing 247 twin-engined, stressed-skin, all-metal monoplane then being built by Boeing for its rival United Air Lines. The 247 was the first "modern-type" transport aeroplane, and its development had been started early in 1932 as a result of experience gained with the single-engine Boeing Monomail monoplane transport, first flown on May 22, 1930, two of which had been operated from 1931 by Boeing Air Transport, one of the constituent airlines from which United had been formed. The 247 flew for the first time on February 8, 1933, and the first of 60 ordered by United went into service soon afterwards. Thirty had been delivered by June and by then it was clear that TWA's fears of the competitive effectiveness of the new type were well founded.

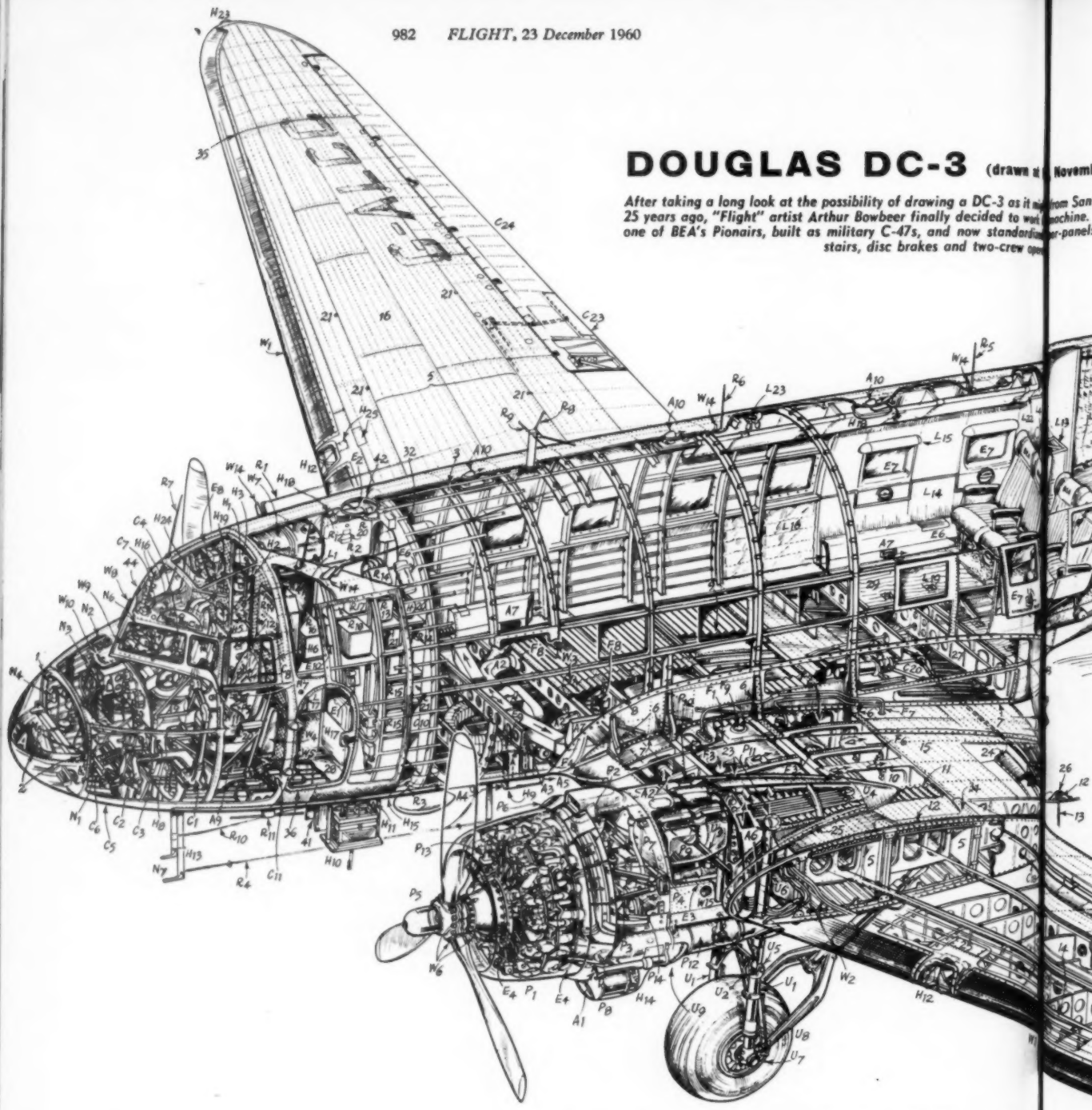
The first "Douglas Commercial," the DC-1, originated in August 1932, the month in which Ford stopped making his famous Tri-Motors. TWA, under the leadership of its vice-president operations, Jack Frye, had recently issued a specification for a three-engined monoplane of metal construction which was to weigh about 14,000lb and carry at least 12 passengers 1,000 miles at 150 m.p.h. This requirement was submitted to two manufacturers, General Aviation Inc and the Douglas Aircraft Company. General Aviation were unable to find the necessary finance, but Douglas—though their fortunes were at a very low ebb at that time—managed to do so. Encouraged by Harold E. Talbott Jnr, chairman of North American Aviation (a major shareholder in both Douglas and TWA), Donald Douglas got his chief designer, Arthur E. Raymond, with his assistant, E. F. Burton, to produce

(Continued on page 984, after double-page drawing of DC-3)

The DC-3 had its origin in the DC-1 (left), a one-off prototype which first flew on July 1, 1933. It went into production with a lengthened fuselage as the DC-2, proving itself in airline service and (right) in the England - Australia Race of 1934

DOUGLAS DC-3 (drawn a[t] November

After taking a long look at the possibility of drawing a DC-3 as it m[ight] from Santa M[onica] 25 years ago, "Flight" artist Arthur Bowbeer finally decided to work[on] machine. He chose one of BEA's Pionairs, built as military C-47s, and now standardis[ed] with cargo-doors, passenger-doors, window-panels, inward-opening emergency exits, stairs, disc brakes and two-crew operation.



Structural and General: (1) Hinged nose cowl; (2) Four spring-catches; (3) L-section stringers over rolled channel-section frames; (4) Tail-section joint ring; (5) Three-spar torsion box; (6) Fuselage/wing attachments; four each side; (7) Fuselage attachment angle; (8) Auxiliary spar; (9) Corrugated centre-section skin; (10) Arch-ribs in fuel tank bays; (11) Corrugations continue as inner skin; (12) Multi-bolt wing joint; (13) Centre section closing-rib (floating); (14) Spar double boom fades out; (15) Centre-section skin 19 s.w.g.; (16) Wing skin 21 s.w.g.; (17) Fuselage skin 21 s.w.g.; (18) Multi-spar fin and tailplane; (19) tailplane halves bolted on centre-line; (20) Tailplane/fuselage multi-bolt attachment; (21) Wing slinging point; (22) Tail slinging point access; (23) Nacelle slinging points; (24) Flap well; (25) Permanently attached nacelles; (26) Fairing strip over wing-joint; (27) Alloy floor-beams; (28) Alloy floor panels forward of cabin; (29) ¼in multi-ply cabin floor; (30) ⅛in multi-ply vestibule floor; (31) Balsa and ply toilet floor; (32) Passenger cabin bulkhead; (33) Tailwheel truss-frame; (34) External doublers; (35) Detachable wingtip; (36) Crew and forward freight door; (37) Passenger door and steps; (38) Three door latches; (39) Operating handle for (38); (40) Flexible handrails; (41) Battery compartment doors; (42) Astro-hatch provision; (43) One-piece fillet; (44) Bird-proof windscreens; (45) Snubber for (37).

Cabin Air System: (A1) Air to exhaust-muff heat-exchanger; (A2) Warm-air trunks; (A3) Mixing chamber; (A4) Cold air to (A3); (A5) Hot air overboard; (A6) Spill valve; (A7) Cabin wall delivery duct; (A8) Ground warm-air connection (starboard); (A9) Pilots' warm air outlets; (A10) Air out via roof lights.

Controls: (C1) Dual control-columns; (C2) Rudder pedal/toe-brake units; (C3) Side-kicking length adjustment; (C4) Centre console; (C5) Access panel below; (C6) Brake cross-shaft; (C7) Magneto switches; (C8) Propeller de-icing control; (C9) Cockpit hot-air control; (C10) Cabin-air control (on aft face); (C11) Sperry A3 autopilot; (C12) Elevator cables; (C13) Rudder cables; (C14) Elevator trim cables, drums (C15) Rudder trim cables, drums; (C16) Rudder-stop cables; (C17) Tailwheel-lock cables; (C18) Aileron cables and levers; (C19) Control-lock lugs; (C20) Flap actuator; (C21) Flap linkage; (C22) Limit of split flaps; (C23) Aileron trim tab (starboard only); (C24) Fabric-covered controls.

Emergency Equipment: (E1) Emergency lighting box (inertia switch and 6V battery); (E2) Hand fire-extinguisher; (E3) Two fire bottles in each nacelle; (E4) Graviner spray-rings; (E5) Two floating survival-cots under rear seats; (E6) Life jackets; (E7) Four emergency windows; (E8) Crew escape hatch; (E9) Two crash-inertia switches on beam; (E10) First-aid box.

Fuel System: (F1) Main tanks, 168 Imp gal each side; (F2) Aux tanks; 167 Imp gal each side; (F3) Gravity filling points; (F4) Twin wobble-pumps; (F5) Pilots' handle for (F4); (F6) Tank bay vents; (F7) Tank vent pipes; (F8) Fuel selector valves; (F9) Fuel-gauge unit access.

November 1960)

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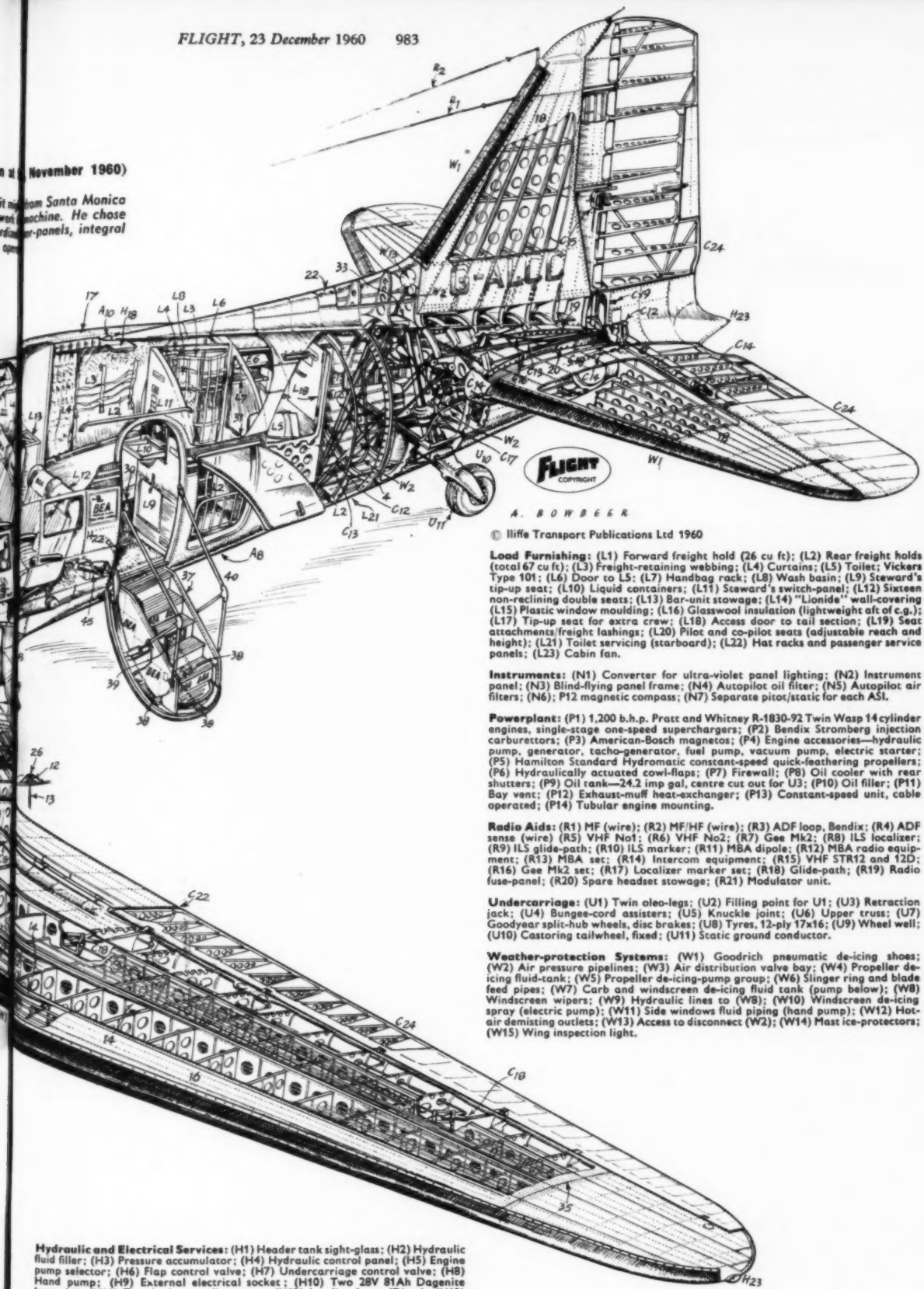

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Load Furnishing: (L1) Forward freight hold (26 cu ft); (L2) Rear freight holds (total 67 cu ft); (L3) Freight-retaining webbing; (L4) Curtains; (L5) Toilet; Vickers Type 101; (L6) Door to L5; (L7) Handbag rack; (L8) Wash basin; (L9) Steward's tip-up seat; (L10) Liquid containers; (L11) Steward's switch-panel; (L12) Sixteen non-reclining double seats; (L13) Bar-unit stowage; (L14) "Lionide" wall-covering (L15) Plastic window moulding; (L16) Glasswool insulation (lightweight aft of c.g.); (L17) Tip-up seat for extra crew; (L18) Access door to tail section; (L19) Seat attachments/freight lashings; (L20) Pilot and co-pilot seats (adjustable reach and height); (L21) Toilet servicing (starboard); (L22) Hat racks and passenger service panels; (L23) Cabin fan.

Instruments: (N1) Converter for ultra-violet panel lighting; (N2) Instrument panel; (N3) Blind-flying panel frame; (N4) Autopilot oil filter; (N5) Autopilot air filters; (N6); P12 magnetic compass; (N7) Separate pitot/static for each ASI.

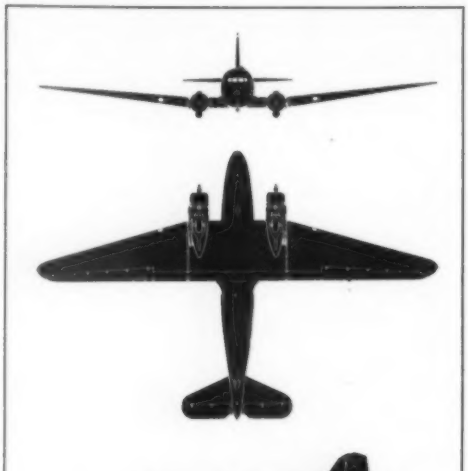
Powerplant: (P1) 1,200 b.h.p. Pratt and Whitney R-1830-92 Twin Wasp 14 cylinder engines, single-stage one-speed superchargers; (P2) Bendix Stromberg injection carburettors; (P3) American-Bosch magnetos; (P4) Engine accessories—hydraulic pump, generator, tacho-generator, fuel pump, vacuum pump, electric starter; (P5) Hamilton Standard Hydromatic constant-speed quick-feathering propellers; (P6) Hydraulically actuated cowl-flaps; (P7) Firewall; (P8) Oil cooler with rear shutters; (P9) Oil tank—24.2 imp gal, centre cut out for U3; (P10) Oil filler; (P11) Bay vent; (P12) Exhaust-muff heat-exchanger; (P13) Constant-speed unit, cable operated; (P14) Tubular engine mounting.

Radio Aids: (R1) MF (wire); (R2) MF/HF (wire); (R3) ADF loop, Bendix; (R4) ADF sense (wire) (R5) VHF No1; (R6) VHF No2; (R7) Gee Mk2; (R8) ILS localizer; (R9) ILS glide-path; (R10) ILS marker; (R11) MBA dipole; (R12) MBA radio equipment; (R13) MBA set; (R14) Intercom equipment; (R15) VHF STR12 and 12D; (R16) Gee Mk2 set; (R17) Localizer marker set; (R18) Glide-path; (R19) Radio fuse-panel; (R20) Spare headset stowage; (R21) Modulator unit.

Undercarriage: (U1) Twin oleo-legs; (U2) Filling point for U1; (U3) Retraction jack; (U4) Bungee-cord assisters; (U5) Knuckle joint; (U6) Upper truss; (U7) Goodyear split-hub wheels, disc brakes; (U8) Tyres, 12-ply 17x16; (U9) Wheel well; (U10) Castoring tailwheel, fixed; (U11) Static ground conductor.

Weather-protection Systems: (W1) Goodrich pneumatic de-icing shoes; (W2) Air pressure pipelines; (W3) Air distribution valve bay; (W4) Propeller de-icing fluid-tank; (W5) Propeller de-icing-pump group; (W6) Slinger ring and blade feed pipes; (W7) Carb and windscreen de-icing fluid tank (pump below); (W8) Windscreen wipers; (W9) Hydraulic lines to (W8); (W10) Windscreen de-icing spray (electric pump); (W11) Side windows fluid piping (hand pump); (W12) Hot-air demisting outlets; (W13) Access to disconnect (W2); (W14) Mast ice-protectors; (W15) Wing inspection light.

Hydraulic and Electrical Services: (H1) Header tank sight-glass; (H2) Hydraulic fluid filler; (H3) Pressure accumulator; (H4) Hydraulic control panel; (H5) Engine pump selector; (H6) Flap control valve; (H7) Undercarriage control valve; (H8) Hand pump; (H9) External electrical socket; (H10) Two 28V 81Ah Dagenite batteries; (H11) Terminals auto-disconnect; (H12) Landing lamp (Dietz); (H13) Electrically heated pitot-heads; (H14) One 28V 50amp generator on each engine; (H15) Electrical duct with outside access; (H16) Switch panels; (H17) Main fuse panels; (H18) Roof lights; (H19) Nav. lights flasher selector and tell-tale; (H20) Inverter; (H21) Voltage regulators; (H22) Entry light; (H23) Navigation lights; (H24) Cockpit wander-lamp; (H25) Access to H12.



THE DC-3 IS TWENTY-FIVE . . .

a project for a twin-engined low-wing monoplane specifically intended to beat the Boeing 247, some details of which were reaching Santa Monica from the Boeing plant at Seattle, 1,000 miles away to the north. The project is said to have been completed in five days and final details were worked out in the train by Harry Wentzel and Raymond on their way from Los Angeles to New York, where their proposals were submitted to TWA.

On the strength of TWA's expression of interest, Douglas undertook the design and manufacture of the DC-1 prototype. Manufacture started early in 1933 and construction went ahead so rapidly that the aircraft was completed inside six months. It was an all-metal monoplane which employed the stressed-skin "multi-cellular" form of wing construction which had previously been pioneered by John K. Northrop in a successful series of single-engined transport aircraft, starting with the Alpha of 1930. Northrop's company had been acquired by Douglas as a subsidiary in January 1932 and the latter firm had built 38 Northrop Gammas employing this form of construction, so it was natural that they should apply it to the new design.

The important characteristic of the wing was three spanwise plate webs to take the vertical shear loads and, in conjunction with the stiffened skin, act as the main structural member. Other features of the DC-1 handed down from Northrop were split flaps on the thin NACA 2215/2209-section wing and long-chord NACA engine cowlings. The DC-1 had a span of 85ft (compared with 74ft of the Boeing 247), a wing area of 942 sq ft (Boeing: 836 sq ft) and a length of 60ft. The design gross weight was 17,800lb—considerably more than the 12,650lb of the 247, in spite of the fact that the Douglas was designed to carry 12 passengers, only two more than the Boeing. The larger size of the DC-1 resulted from the type's greater design range and it dictated larger engines than the 550 h.p. Pratt & Whitney Wasps in the 247. Wright R-1820-F Cyclones of 710 h.p. were selected. It is interesting that (according to Raymond) the structure weight of the DC-1 came out no less than 30 per cent above the design estimates. This and the aircraft's size convinced TWA that the passenger capacity should be increased; so the DC-2 production version, 20 of which the airline ordered on September 4, 1933, had its fuselage stretched by two feet to accommodate 14 passengers. Fitting of variable-pitch propellers, instead of the fixed-pitch type originally projected, enabled the gross weight to be increased to 18,080lb and thus improved the percentage structural weight.

Before this, on July 1, the DC-1 prototype (X223Y) had made its first flight at Douglas's Clover Field at Santa Monica. Piloted by the manufacturer's chief test pilot, Carl Cover, the DC-1 had an eventful first flight. A fault in the fuel system caused the engines to cut whenever the nose was lifted into a steep climb; but, by careful handling, Cover managed to get the aircraft back on to the ground without damage. The fault was easily cured and the DC-1 was soon being put through an intensive flight-test programme which quickly established its outstanding qualities. Particularly notable was the single-engine performance, which was superior to that of any contemporary.

The aircraft was delivered to TWA in December 1933 (as NC223Y) and thereafter was used for proving and experimental flying and for testing various alternative engine installations, equipment and navigational aids. In 1936 Howard Hughes, TWA's chief shareholder, acquired the DC-1 and contemplated using it for a round-the-world flight—which, however, he eventually made in a Lockheed 14. In 1938 the DC-1 was sold to Viscount Forbes and shipped to England, where it was registered G-AFIF. Shortly afterwards it was sold to Spain and operated by the Republican Government airline LAPE during the Civil War. After the war ended, the DC-1 was taken over by the Nationalist airline SAETA (later to become Iberia), which put it into scheduled service as EC-AAE on the Spanish domestic routes in May 1939. This famous aeroplane ended its career in December 1940 when it suffered engine failure while taking off from Malaga on a scheduled service. The pilot, Capt Rudolfo Bay, managed to land straight ahead without injuring any of the occupants, but the aeroplane itself was damaged beyond repair.

The first DC-2 (NC13301), with its lengthened fuselage, flew for the first time on May 11, 1934, and made its initial flight with TWA between Columbus, Newark and Pittsburgh only a week later, on May 18. It went into regular service in July. This first DC-2, which became known in TWA as "Old 301," gave five years of faithful service with the airline during which it flew about 15,000 hours until, in 1941, it was bought with several other DC-2s by the British Purchasing Commission and shipped to India. There it did good work as a military transport for about two more years before going unserviceable and being cannibalized for spares at Juhu Airport, Bombay.

By the time the first DC-2s were in service TWA had increased its order to 26 and other airlines were also negotiating orders. The DC-2 had the same wing as the DC-1, but its loaded weight was increased ultimately to 18,560lb. The accommodation for 14 passengers was in single 19in-wide seats at a pitch of 40in, arranged on each side of a central 16in aisle. The cabin had a maximum width of 5ft 6in and a maximum height of 6ft 3in. A total of 220 DC-2s were built, the hundredth being delivered to American Airlines on June 5, 1935, less than 13 months after the first aircraft had been delivered to TWA. From the end of 1934 ten DC-2s a month were in fact being produced, and 160 had been built for the airlines by the time production was completed in 1936. Considerable numbers were exported, the first to arrive in Europe being for KLM; they were landed from the s.s. *Statendam* on September 11, 1934. Others for Swissair followed soon afterwards. Seven other foreign airlines bought DC-2s.

Proved in a Race

Impressive evidence of the DC-2's capabilities was provided by the famous MacRobertson Race, flown from Mildenhall, Suffolk, to Melbourne in October 1934. A KLM DC-2 flown by two of the airline's senior pilots, Parmentier and Moll, and carrying a load of special fare-paying passengers, came second in the race, taking three-and-three-quarter days to cover the 12,000 miles; it was beaten only by a de Havilland Comet racer, which took just under three days. The DC-2 was used by KLM to operate, among other services, its long-distance trunk route between Holland and the Dutch East Indies (now Indonesia).

Initial development of the DC-1/2 is said to have cost Douglas rather more than $300,000 (£60,000) and production aircraft were sold for $65,000 (£13,000) each. Break-even is believed to have been reached after 75 had been built.

The economic and competitive success of the DC-2 was phenomenal. The type proved to be significantly cheaper to operate per seat-mile than the Boeing 247, which itself had a specific operating cost about 20 per cent lower than that of the Ford Tri-Motor which had preceded it. At the same time, the DC-2 was about 10 m.p.h. faster than the improved 247D and, with its much larger cabin, had very much more passenger appeal. Many of the United States domestic carriers soon realized this; five were forced by competitive factors to follow TWA's lead and also buy DC-2s. Although DC-2s remained in American service in significant numbers only up to 1941, the type did survive in airline use abroad well into the 1950s and a few are probably still flying today. One DC-2 with Australian National Airways had flown

DC-3 FLYING COSTS

For a Typical UK Independent Operator in 1960

Cost Item		Cost per Hour (£)
Fuel		10.0
Oil		0.5
Landing fees		2.0
Landing charges*		2.5
Passenger services		5.4
Aircrew costs		8.0
Engineering		12.0
Overhead		10.0
Total		£50.4
Block speed		150 m.p.h.
Passenger seating	36	32
Total cost per seat mile	2.2 pence	2.5 pence

*Appropriate to inclusive-tour-type operations into the Mediterranean area.

nearly 30,000 hours when it was retired in 1946 and it is possible that others exceeded this total.

Among the leading carriers who bought DC-2s was American Airlines, and early in 1935 discussions between this operator and Douglas resulted in a further development of the basic DC-1 design. American's president, C. R. Smith, wanted for his Southern transcontinental routes a new sleeper transport which could replace the Curtiss Condor biplanes then in service as "coast-to-coast" sleepers. The talks led to a stretched version of the DC-2 with an enlarged fuselage, higher operating weights and more powerful engines. Although Douglas was at first doubtful about the economic case, construction started in mid-1935 and the firm tooled-up to manufacture 25. The fuselage was widened by 26in (to 7ft 8in) and deepened by 3in (to 6ft 6in), while its length was increased by about 2½ft. Sufficient volume was thus provided for berths for 14 passengers—the same number as the DC-2 accommodated in seats—plus a small cabin, known as the "honeymoon suite," forward. The new type was at first known as the DST—"Douglas Sleeper Transport"—but was soon named DC-3 in its "Day Plane" version, which accommodated 21 passengers in 21in-wide seats at 40in pitch arranged three-abreast in double units on one side of the 19in aisle and singly on the other.

Take-off weight of the DC-3 was increased at first to 24,000lb and the power raised to 1,000 h.p. each with R-1820-G Wright Cyclones. At the same time the tail surfaces were enlarged and the wing area was increased about five per cent to 987 sq ft by adding pointed 5ft extensions at each tip, thus putting up the span to 95ft. The flaps-down stalling speed was in this way held down to 64 m.p.h., only three miles per hour more than that of the DC-2. The cruising speed remained about the same at around 170 m.p.h. on 50 per cent of take-off power.

Economic Achievement

The economic characteristics of the DC-3 proved to be a considerable advance on those of the DC-2 while, compared with the Boeing 247, the DC-3 had seat-mile costs about 25 per cent lower. The economy of the DC-3 played a major part in the financial progress of the American domestic airlines between the mid-1930s and 1950, when they first achieved overall profitability without subsidy. In the mid-1930s the US airlines were covering less than two-thirds of their costs. Fifteen years later they were profitable in spite of the fact that their fares (expressed in constant money-values) had been reduced about 40 per cent during the period. From Douglas's point of view also, the DC-3 was soon a financial success. About $1,200,000 (£240,000) is believed to have been spent on the type's initial development. At a purchase price of between $90,000 and $115,000 (£18,000 to £23,000) break-even was achieved after about 50 had been built.

The first DC-3 (X14988)—a DST of the type ordered by American Airlines—was flown by Carl Cover for the first time at Santa Monica on December 22, 1935. Though the new type quickly proved its worth, directional stability during early test flying was found to be deficient and the DC-3's characteristic dorsal fillet was soon added in front of the fin.

The design was obviously so promising that the initial order from American Airlines for ten aircraft was soon increased to eight DSTs and 12 DC-3s; and in March 1936 W. A. Patterson, president of United Air Lines, ordered ten DSTs and soon afterwards five DC-3s. The aircraft for United were to be DC-3As with Pratt & Whitney Twin Wasps of 1,150 h.p. This type of engine (with its maximum power increased to 1,200 h.p.) was later to prove to be the most popular type in the DC-3. In due course, the maximum take-off weight of the DC-3A was increased to 25,200lb in American airline service and to 28,000lb in most other countries. In military roles, take-off weights of 30,000lb or more were common.

The first four DSTs had been delivered to American Airlines when scheduled services, between New York and Chicago, started on June 25, 1936. At least two of these first DSTs (all DSTs were later converted into DC-3s) are still flying today: NC16004 (the fifth built) is now an executive aircraft with the Pacific Lumber Company of San Francisco and NC16005 (the sixth) is still in scheduled service with the US local-service carrier, Ozark Air Lines.

Orders for DC-3s came rapidly and in large numbers soon after the type entered service; 150 had been ordered, and most of these delivered, within eighteen months. By 1939, DC-3s were carrying about three-quarters of the United States domestic air traffic. By time America entered the war in December 1941, 360 DC-3s were in service on her domestic routes. Although nearly 200 of these were soon commandeered for military transport duties, the remainder—operated at fantastically high utilizations—continued to provide almost all (93 per cent) of America's internal air transport until the end of the war. By 1941 more than 800 DC-3s had been built, 450 of these for airline use at home and for 30 other airlines all over the world. By then the DC-3 comfortably outnumbered the three-engined German Junkers Ju52/3m which, up to the outbreak of war, had been the airliner in most numerous service (300 were in commercial operation in 1939).

About 4,000 Ju52s are believed to have been built, mostly for military purposes, but the DC-3 was soon to eclipse even this large total. Even before they entered the war the American forces had ordered developments of the DC-3 in considerable numbers. However, once they became involved, they showed very clearly that they realized the importance of air transport to the most effective conduct of the war. Large orders were placed for, particularly, the C-47 and C-53 military versions. Up to August 1945, when production finally ceased, no fewer than 10,125 military models of the DC-3 had been built, mainly at the Douglas plants at Long Beach and Oklahoma City. At one time, in mid-1944, they were rolling off the assembly lines at a rate of nearly two an hour. But the DC-3 was not produced only in America; before the war, licences to build the type had been sold to Britain, Holland, Russia and Japan. In the event, production was not undertaken in Britain or Holland, but the Russians tooled up to do so; they are believed to have built about 2,000 of a version which they called the PS-84 in military service and which has become known as the Lisunov Li-2 since the war. (Boris Lisunov, a Soviet engineer, spent two years at the Douglas factory obtaining the information needed to put the type into production in Russia.) The Japanese also built the DC-3, about 450 of their Showa L.2D model being made. Thus it was that, by 1946, well over 13,000 aircraft of DC-3 design had been produced, 10,928 of them in the United States. About 2,000 American-built military DC-3s were supplied to Britain and other allied countries under Lease-Lend—in the RAF the type was known as the Dakota—and about 700 were sent to Russia.

At the end of the war thousands of surplus military DC-3s were thrown on the civil market. At prices ranging from as low as $8,000 to $15,000 (£2,000 to £3,700) they were bought up by operators all over the world. A few were even sold for as little as $1,200 (£300). At first it was thought that these aircraft would not survive long. Indeed, as early as 1942 the American CAB had indicated that it would not certificate DC-3s for commercial use after 1947. In the years following the war, licensing authorities in various parts of the world have repeatedly put deadlines on the further use of DC-3s; but these have always had to be extended, and today (although increased weight limitations have recently been placed on DC-3 operation from airfields at high altitudes and temperatures) it is generally recognized that the type is likely to continue in use for an indefinite period. For this there are good reasons. Safety statistics show that, although the DC-3 does not satisfy modern theoretical airworthiness requirements, in practice the type has proved a good deal safer than many more recent designs. Another reason is that, although many manufacturers have produced so-called "DC-3 replacements," no new type has yet succeeded in tapping more than a small part of the market. In 1949 Douglas themselves sought to meet the replacement requirement with a revamped DC-3 which they called the Super DC-3. The idea was that DC-3s should be rebuilt with new wing and tail surfaces, more powerful engines and a fuselage lengthened by 2½ft. The idea did not catch on: at $250,000 (£62,000) a time, commercial operators found the Super DC-3 too expensive. The US Navy ordered a hundred, but the majority of operators preferred to continue with the DC-3 itself, even though its second-hand price had by now increased considerably above its immediate

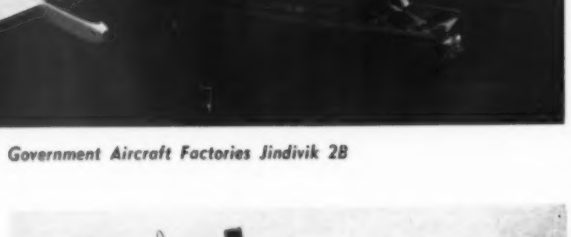
(*Concluded on page 998*)

"It's a DC-3 replacement" (a cartoon first published in "Flight" two years ago and even more apposite today)

Targets and Drones

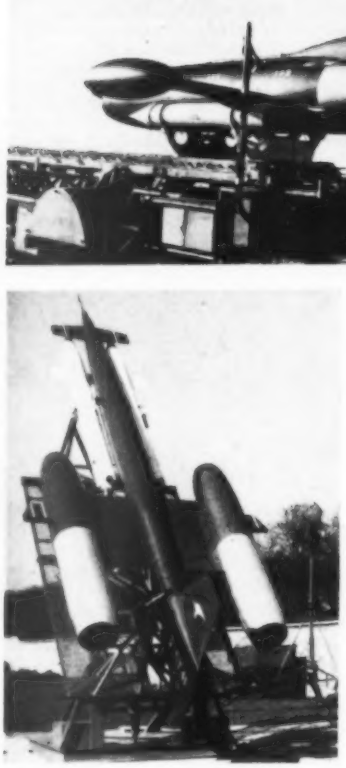
A "FLIGHT" COMPILATION OF THE PILOTLESS VEHICLES OF THE WESTERN WORLD

Government Aircraft Factories Jindivik 2B



Nord CT-10

Above, Nord CT-20



Left, Nord CT-41

EVER since Elmer Sperry developed a practical autopilot in 1910, aeroplanes without pilots have engaged the attention of many inventors, and from the semi-successful projects of the inter-war years have stemmed two main classes of contemporary vehicle. The first are the guided weapons which today form the bulk of the primary delivery systems of any top-line fighting force; the second is a family which may be described as embracing targets and drones.

All the members of this second family are basically miniature aeroplanes, and their functions are manifold. By far the most important role is that of acting as an Aunt Sally for all forms of anti-aircraft defensive systems. On the other hand the hard-worked drones—surely a contradiction in terms—are already assuming functions previously the prerogative of piloted aeroplanes; for example, they are already engaged in reconnaissance by visual, TV and infra-red methods, electronic countermeasures and a variety of more classified types of mission. In addition, related devices are employed as test-beds for powerplants (especially for ramjets) and in aerodynamic research.

What follows is a catalogue of the many Western aircraft which come within these overall categories. Their diversity is astonishing; although the simplest targets cost less than a small family car, some of the more sophisticated vehicles are priced at appreciably more than a fully equipped bomber of World War 2. If there are any trends discernible they are all associated with the increasing complexity and specialization of each of the systems considered.

Ten years ago the standard types of target had a performance of some 150 to 200 m.p.h. at an operating height of below 10,000ft. This sufficed admirably for light A.A. guns, such as the Bofors; but today there are targets which can not only fly at three times the speed of sound, at over 100,000ft altitude, but by incorporating clever electronic devices can present a radar picture which is a faithful representation of any of perhaps a dozen types of aeroplane each much larger than the target itself.

AUSTRALIA

GAF *Government Aircraft Factories, Fishermen's Bend, Melbourne.*

Jindivik In view of the prolific range of targets and drones developed in other countries one must conclude that the solitary vehicle designed for such work in the British Commonwealth should be of singular efficiency. This is indeed the case, and the latest marks of Jindivik are now in large-scale production, principally for use at the WRE Woomera, but also for export to the United Kingdom and other countries.

It was early in 1948 that, following meetings between representatives of the Ministry of Supply and their opposite numbers in Australia, a specification was issued for a high-speed pilotless target. Initial problems were solved with the aid of a piloted version, and the first true Jindivik, launched without boost from a self-steering re-usable trolley, was delivered to Woomera in November 1951. The original order for six Mk 1s was later doubled, and these entered service in the winter 1952-53. The Mk 1 was powered by an Armstrong Siddeley Adder turbojet, and carried an Elliott-built autopilot, GEC-built remote-control equipment and McMichael telemetering gear, all originally developed at the RAE. The last Mk 1 was delivered in 1954.

The first of four prototype Jindivik Mk 2s flew in December 1953, powered by a Viper turbojet of 1,640lb thrust. Following a first batch of 50, further orders were placed by Australia, Great Britain and Sweden. The first British contract was for ten, and at least 40 more have since been ordered for use at Aberporth, operating out of Llanbedr. The Swedish order was for ten, said to cost £400,000 with ground equipment and spares.

In 1958 a much-improved prototype, designated Jindivik 2A, was flown to prove aerodynamic alterations aimed at extending the operational altitude. This aircraft paved the way for the current Mks 2B, 2C, 3 and 3A. The first two variants are powered by a Bristol Siddeley Viper ASV.8, while the Mk 3 family have the more powerful ASV.11. Most important current production model is the 2B, to which the following details apply. Within the forward fuselage are housed the major elements of the control and guidance systems. Access to this equipment can be gained by removing the large canopy which forms the front portion of the engine intake duct. The centre fuselage contains the main fuel tank and encloses the engine compressor zone. To it are attached the retractable centreline landing skid and the constant-section wings which form integral fuel tanks. In the lower forward

portion of the centre fuselage is a special-equipment bay with a capacity of 12 cu ft. The engine is exposed by removing the rear fuselage and tail.

Jindivik's command-guidance system permits push-button control from a ground station or parent aircraft. The command signal is transmitted in the form of two audio tones which frequency-modulate a carrier wave. To transmit command information eight tones are available, and different pairs of tones are used for any given command. A total of 24 signals may be transmitted, 18 for normal flying and 6 for control of special equipment such as flares or miss-distances cameras. The airborne receiver translates the audio tones into direct commands and, since it normally rejects any signal other than a pair of tones, cannot receive two commands concurrently. During the landing sequence the drone may be controlled from two positions simultaneously, when it will respond smoothly to the sampled signals from both operators.

Special equipment can be carried in the fuselage bay, while Mk 4 nacelles are mounted well inboard from the extended tips of current versions. Each nacelle houses two miss-distance cameras covering 186° solid angle each. Precise details of the trials equipment which Jindivik can carry remain classified, but apart from the camera pods (described presently) the following may be listed: FH (flare-heated) sources for simulating the jet efflux of large aircraft; IR (infra-red) lamps grouped to put out several kilowatts in a rearwards direction; IR flares which can be towed at a specified distance behind the target, so that the latter may not be destroyed by an exploding missile; and X-band and S-band Luneberg lenses and transponders for enhancing radar return and acquisition. Early types of Jindivik carried on their wing-tips Mk 2 Ampor (airborne missile proximity) nacelles carrying several cameras in order to achieve all-round photographic coverage for missiles arriving from any quarter. Present Jindiviks carry the flat-sided Mk 4 pod with a maximum depth of 11in. Each houses two Wretar cameras, developed jointly by the WRE and Fairey Australasia; the Wretar has a field of view of 186°, and one pair aligned in opposite directions can cover the whole area around the Jindivik without blind spots.

The Jindivik 2B is currently in production both for the WRE and for use in Britain. Whereas the mean achieved life in 1958 was 14 flights (an excellent figure) it has now risen to over 20; some Jindiviks have flown more than 40 times. From May 1961 the more powerful Jindivik 3A will become available, with an improved autopilot, telemetry equipment and power supplies in order to achieve better handling qualities at greater altitudes. European sales rights are held by Fairey Engineering, who are also responsible for the introduction of targets into UK service and for all maintenance, repairs and modifications. This work has involved Heston and White Waltham, but is now centred at Stockport.

GREAT BRITAIN

ENGLISH ELECTRIC *English Electric Aviation, London SW1.*

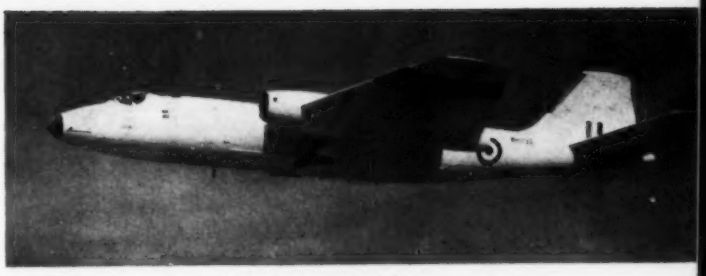
Canberra A target version of the Canberra, designated U.10, has been evolved by Short Bros & Harland Ltd, in conjunction with English Electric, as a conversion of the B.2 bomber. The U.10 has a sophisticated control system providing for command guidance from a ground station or parent aircraft. Not only can all phases of flight be controlled remotely but the ancillary equipment is also automatic: flaps, fuel, drag-parachute, air brakes, wheel brakes, landing gear and associated command radio, telemetering, navigation, miss-distance recording, command destruction and other specialist equipment. Canberra U.10s have frequently flown under automatic control at heights greater than 50,000ft. A number are in service at Woomera for use in conjunction with tests of advanced missile systems.

FAIREY *Aircraft originally constructed by Fairey Aviation Ltd, now part of Westland Aircraft.*

Firefly Two versions of these former Royal Navy strike fighters have been converted for service as targets. The first such conversion was the U.8, derived from the three-seat AS.7 and widely employed over Cardigan Bay and Woomera. The second variant is the U.9, evolved from the two-seat Firefly 5. Firefly U.9s equip 728B Sqn of the Royal Navy at Hal Far, Malta, the unit responsible for providing targets for the Seaslug trials ship HMS *Girdle Ness* and for Mediterranean RN squadrons equipped with Firestreak missiles. All these drones have radio control and miss-distance cameras.

GLOSTER *Gloster Aircraft Co Ltd, Gloucester.*

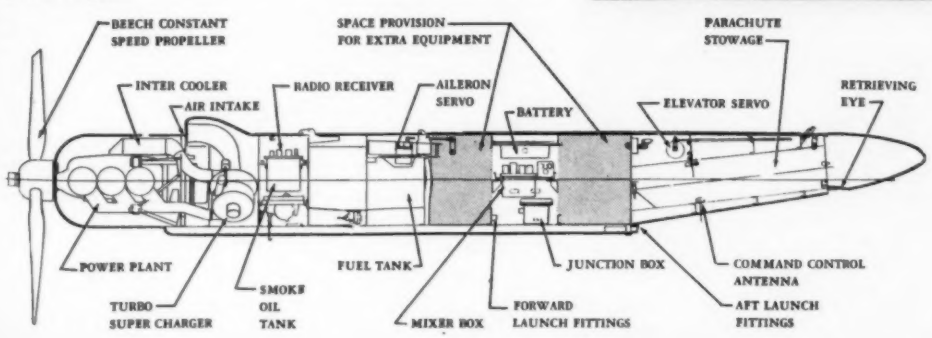
Meteor Since 1955 Flight Refuelling Ltd have, at their airfield at Tarrant Rushton, Dorset, converted a number of Meteor F.4 and F.8 fighters to serve as remotely controlled U.15 and U.16 targets. Under contract to the MoA or MoS, and in collaboration with the RAE and other firms, they have incorporated modifications to the flying controls and structural revision to permit the installation of specialist instrumentation and radio equipment. Camera pods are carried on the wing-tips, and control may be exercised either from the ground or from a mother aircraft. These Meteors have frequently been destroyed by guided weapons.



English Electric (Short & Harland) Canberra U.10

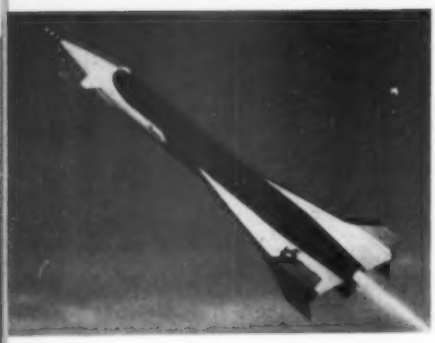
Above, Gloster (Flight Refuelling) Meteor U.15

Right, Aerojet-General SD-2 (long version)



Above, Beech KDB-1 and (left) inboard profile, showing internal equipment

Targets and Drones . . .



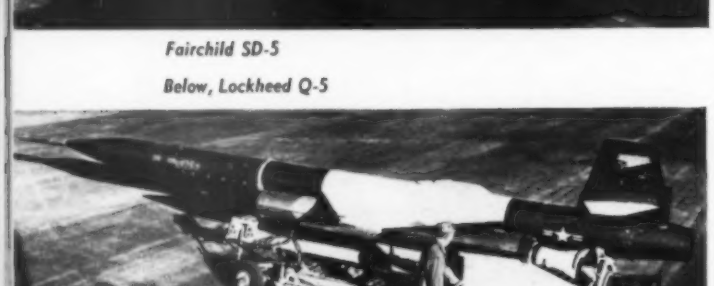
Beech KD2B-1 (WS-462L)

Below, Boeing (Lockheed) QB-47

Chance Vought KD2U-1

Fairchild SD-5

Below, Lockheed Q-5



FRANCE

NORD *Nord Aviation, Rue Beranger, Chatillon-s/Bagneux.*

CT-10 Betraying its descent from the Fi103 ("V-1") flying bomb, the CT-10 employs a Nord pulse-jet engine, is launched from a ramp by twin boost rockets, has flip-flop radio control and may be recovered by parachute. Its chief merits are its reliability and modest first cost. A number have been exported, and a small batch is made each year for the Royal Navy (Malta).

CT-20 Of more advanced design, the CT-20 is powered by a Turboméca Marboré turbojet and is launched by twin boost rockets from a 33ft ramp, at the end of which the speed is approximately 375 m.p.h. The vehicle is stabilized about all three axes and controlled by a radio-link with the ground or a mother aircraft. Flip/flop control is employed, the standard commands being: turn right, turn left, pitch up, pitch down, open throttle, engine idle, produce smoke, operate cameras, light tracking flares, land. On the last command a parachute system is deployed and the target descends in a horizontal attitude, impact being cushioned by an air bag which also provides flotation. Over 350 have so far been delivered to the *Armée de l'Air* and to the governments of Britain, Italy and Sweden; 100 more are on order.

CT-41 Design of this highly supersonic vehicle was initiated during 1957, and development has since been assisted by Nord's experience with earlier targets and guided weapons. It is a canard, powered by twin Type 625 ramjets on the tips of the stubby unswept wing, and accelerated to M1.6 by twin boost motors linked by a short aerofoil and attached beneath the forward fuselage. Control is provided by a moving foreplane and diminutive wedge-section roll controls outboard of the engines. The vehicle is assembled from five major elements, packaged separately and bolted together in the field. Flight guidance is effected by SFENA radio equipment, which passes nine command channels from a pilot on the ground. On board the target is an autopilot with vertical, rate and turn gyros and an altitude capsule. Flight Mach number is governed according to pilot demand by a sensing unit within the engines. Range, altitude and azimuth are fed to a decoder from a ground interrogator and airborne transponder, and the pilot has repeater instruments giving him target altitude and Mach number. At present the CT-41 is carrying X- and S-band transponders, Luneberg lenses, IR flares, four 180° cameras and a Doppler miss-distance indicator. Provision is made for travelling-wave transponders. Recovery is effected by a two-stage parachute system.

Some of the first test targets suffered structural failure, but current flight-testing in the Sahara is going very well. In November 1959 Hawker Siddeley Aviation purchased manufacturing and sales rights for the CT-41 throughout the British Commonwealth, and last March Bell Aerospace Corp purchased similar rights in respect of the USA.

USA

AEROJET-GENERAL *Aerojet-General Corp, Subsidiary of The General Tire & Rubber Co, Aeronautics Division, Downey, Cal.*

SD-2 Spy At 11711 South Woodruff Avenue is the defence and technical-products division of the former Rheem Manufacturing Co, whom Aerojet purchased in May 1959. Rheem had in 1956 initiated the development of a drone which, although generally similar to earlier targets, had a more powerful engine and higher wing loading in order to achieve higher performance with a greater payload. It was brought to the flight-test stage in 12 months, and after adoption by the US Army as the AN/USD-2, completed basic Army flight trials in October 1958.

From the outset the SD-2 has been intended principally for combat-surveillance. Initially it was designed solely for day and night photographic missions, but later additional fuselage sections were inserted to house "radar, infra-red, high-speed photographic cameras, combinations of these equipments and other of the Army's latest sensory devices." Powerplant is a specially rated Lycoming flat-four (Lycoming's only drone engine) and much of the airframe is moulded in reinforced plastics. The SD-2 is carried upon a single-axle trailer, from which it is zero-length launched by a pair of automatically jettisoned solid boost motors. Control is by radio command, supplemented by an airborne programmer, and recovery is effected by a parachute deployed by command signal. Cognizance for the programme is held by the Army Signal Corps Electronic Proving Ground, at Fort Huachuca, Ariz. After successful testing of the original SD-2 by day and night from April 1959, the long-fuselage version—known only as the "improved SD-2" entered the flight-test stage in April of this year. The extension of the programme stemmed from its outstanding performance during the spring of 1959, and is financed by contracts totalling $6.9m placed in mid-1959.

AERONCA *Aeronca Manufacturing Corp, Middletown, Ohio.*

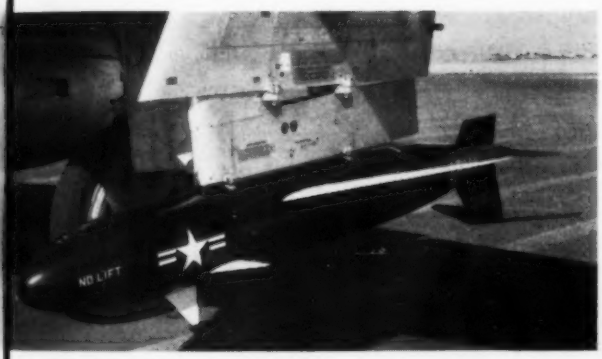
P-106 Last year the US Army sponsored a competition for a low-cost, ground-launched target capable of supersonic speed at both high and low altitudes, for use during missile firings. Aeronca, in association with Emerson Electric and Experiment Inc, proposed the P-106, and the closely related P-107 for the concurrent programme sponsored jointly by the Navy and Air Force. Either would cost less than $10,000 in full production, and cruise propulsion would be provided by a ram-rocket (a ramjet with an internal rocket engine to confer the ability of starting from rest).

BEECH *Beech Aircraft Corp, Wichita 1, Kansas.*

KDB-1 Known as the Beech Model 1001, the KDB-1 is a piston-engined vehicle of the US Navy. Intended for out-of-sight control, in conjunction with air-to-air and surface-to-air weapon systems, it is generally employed as a target although it is potentially versatile. Propulsion is provided by a turbosupercharged 120 h.p. McCulloch flat-6 two-stroke driving a 52in Beech constant-speed propeller.

NAA Redhead-Roadrunner

Radioplane KD2R (Royal Navy)



Radioplane RP-76 carried by F-89J

The KDB can be launched from a North American AJ-2P parent aircraft or from an AT-3 compressed-air catapult or (with two rocket motors) ZL-2B zero-length launcher. Stabilization and command control is provided by a Summers 1032A three-axis, two-servo autopilot, combined with a 6-channel radio receiver and associated with a PAR gyro for roll and yaw stabilization, and a vertical gyro for pitch stabilization. Tracking is arranged by special echo-augmenters or Luneberg lenses in tip pods and tailcone, giving a radar range of 58,000yd with SCR.584 or APS-8A radar; beacon tracking is also provided and visual identification is facilitated by a trail of oil smoke produced by radio command. Recovery is effected by a 40ft reefed canopy, and much of the airframe is filled with foamed plastic to provide floatation.

In order to increase the versatility of this drone, up to 7,200 cu in of stowage space can be made available to accommodate a payload of 175lb (243lb with overload). Roles suggested by Beech include photo and TV (UHF and VHF) reconnaissance, electronic and infra-red countermeasures, battle-area resupply, target location and aerial survey. Other equipment includes a 37-channel telemetry system, into which radiation detectors and counter systems have been integrated, and a vector scoring system (for target roles) accurate to within 5 per cent out to 2,000ft and providing burst distance, miss distance and velocities. Wing pylons can carry individually recoverable pods for cameras up to 9×9.

Formal demonstration flights for BuAer were completed in March 1958, and the following November Beech were awarded a Navy contract valued at some $8.7m for production KDB-1s, deliveries of which were made in the year following May 1959. It is worth noting that one of these targets has already flown to 43,500ft to establish an unofficial altitude record for targets in the KD-300 (medium performance) class.

KD2B-1 In May 1959 it was announced that Beech had won a joint US Navy/Air Force competition for a versatile missile target. Known as the KD2B-1 in the Navy and as WS-462L in the USAF, the new target "fulfils the need for an air-launched, low-cost, high-speed, expendable missile target for the training of intercepter and fighter pilots who will be firing radar-guided or heat-seeking air-to-air missiles." In addition the Navy plans to employ the KD2B as a target for ship-launched missiles. The KD2B is a canard delta, with fixed fins close to the wing tips. Propulsion is provided by a dual-chamber rocket engine operating on pump-fed liquid propellants; both chambers will be used for acceleration to supersonic speed, the larger being shut down at cruising height. The target can be launched from a Nike-Ajax ramp, using the Nike-Ajax tandem boost motor. Alternatively, it can be carried beneath the wings of nine current American fighters and the B-57. Flight duration is 5min at M2 or 8min at M1.5 and the target can cruise at any height from 5,000 to 70,000ft. Equipment includes a programmed guidance and stabilization system, a hit/miss scoring device, installations for increasing radar or IR reflectivity or emissivity, and a destruct system. Operational service is scheduled for 1962.

BOEING *Boeing Airplane Co, Seattle 24, Wash.*

QB-47 Under contract to the USAF Air Research and Development Command, the Georgia Division of Lockheed Aircraft Corp have converted at least 14 Boeing RB-47s into pilotless drones for use in "offensive and defensive test missions at high subsonic speeds and altitudes." The only thing that can exactly simulate another thing is a perfect replica, and the QB-47 can almost faithfully portray modern strategic bombers. The first was flight-tested in the spring of 1959, and a number have now been used in tests against the Dew Line, White Alice and other continental defence systems. Guidance and control for the big drone was developed by Sperry, with command transmission via radar signals and ARW-64 UHF radio. Optical and electronic miss-distance systems are linked to telemeter the performance of missiles direct to ground stations. The QB-47 is equipped to carry chaff dispensers and a wide range of electronic countermeasures, and the examples in use at Eglin AFB are equipped with a hook attached to the rear main leg engaging with a runway arrester system. Since August at least four QB-47s from Eglin have been intercepted over the Gulf Missile Range by Bomarcs, which have either impacted or passed near enough for their dummy warheads to be triggered.

CHANCE VOUGHT *Chance Vought Aircraft Inc, Dallas, Texas.*

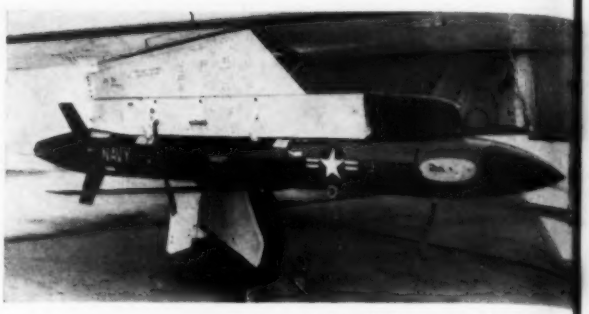
KD2U When the Regulus 2 submarine-launched bombardment missile was cancelled in December 1958, a considerable number of these supersonic, winged, air-breathers were on the assembly line at Dallas. The following year it was agreed that these would be completed as recoverable drones, equipped with a retractable tricycle undercarriage of the type used on the first prototypes. The result, designated KD2U-1 by the Navy and also in service with the Air Force, is a target or drone which can fly at M2 for at least an hour and carry any desired combination of trials equipment. The greatest work now being done by these vehicles is the provision of targets for interception by IM-99B Bomarcs over the Gulf Missile Range. On July 9, for example, a KD2U coming in at 50,000ft at M2 was intercepted by the missile 170 miles down-range. Notes on seven KD2U interceptions were given on page 726 of our November 4 issue.

CURTISS-WRIGHT *Santa Barbara Division, The Curtiss-Wright Corp, Santa Barbara, California.*

TDU-12/B Skydart A number of these supersonic targets have been ordered to investigate missile launching techniques and to train pilots in attack procedure. The sponsor is the Sidewinder Weapon System Project Office of the USAF Air Research and Development Command. Completely expendable, the Skydart has an overall length of 6ft 8in,

Below, Radioplane Q-4B carried by GC-130; bottom, Radioplane RP-77

Republic SD-4



Temco KDT-1 carried by F3H-2

Targets and Drones . . .

and the spans of the canard foreplane and rear-mounted wing are respectively 13 and 20.8in. The Skydart can be launched from an F-100 or F-104 at between M0.8 and M2, at any altitude between 40,000 and 60,000ft. A Grand Central Rocket motor provides boost and sustainer propulsion for 90sec, the trajectory being controlled by ground adjustment of the foreplanes and stabilized by flippers actuated by an autopilot and servo system. On the tail is carried a 90-sec flare which provides a heat source for infra-red homing missiles. Upon termination of forward flight, command impulses detonate the destruct unit. The Curtiss-Wright contract is worth $470,000.

FAIRCHILD *Fairchild Astrionics Division, Wyandanch, NY.*

SD-5 Having a configuration similar to that of the rather smaller Republic SD-4, the AN/USD-5 is an outstandingly capable supersonic tailless-delta vehicle, under development for the US Army Signal Corps. The original programme, negotiated between the Army and Fairchild in 1957, was estimated at $12m and revised to $26m, but in September 1958 modification orders increased the funding to nearly $48m. It was then said that the SD-5 represented "the most advanced thinking in the fields of aviation and electronics."

In June 1959 an announcement by the Minneapolis-Honeywell Regulator Co stated that they held the subcontract, worth several million dollars, for a miniaturized inertial guidance system for this vehicle. The general manager of their plant at St Petersburg, Florida, stated, "the drone's guidance system will enable the Army to pinpoint battle-area targets for such Army missiles as the Redstone, Sergeant, or Pershing, several hundred miles behind enemy lines." The system will be pre-programmed, with radio-command over-ride, and will be able to guide the SD-5 over several target areas in one mission without any external commands, and will finally navigate it back to its own base for recovery by parachute. Surveillance systems operate by photographic, radar and infra-red methods, and later versions will conduct terrain mapping and the monitoring of nuclear explosions. The SD-5 is mounted on an articulated trailer carrying an elevating zero-length launcher. It is accelerated by an underslung solid boost motor of 48,000lb thrust, and cruise propulsion is provided by a Pratt and Whitney J60 turbojet.

The programme is directed technically by the Signal Corps R & D Laboratory at Ft Monmouth, NJ, and evaluation testing is being conducted at Ft Huachuca, Yuma, Arizona. The first flight took place early in May this year and a number of test vehicles have now flown. Production SD-5s will each cost about £140,000 with full equipment, and are due to enter service in the first half of 1964.

LOCKHEED *Lockheed Aircraft Corp, Georgia Division, Marietta, Georgia.*

Q-5 Kingfisher Stemming from the X-7 used for flight-testing the Marquardt RJ43 series of ramjets for the Bomarc, the Q-5 was originally bought by the US Air Force, details being disclosed in October 1957. During the following year Q-5s were delivered to the US Army, and in June 1958 Lockheed received a production contract for $7.5m. On August 12 a Q-5 was successfully intercepted by a Talos missile over the White Sands Missile Range, New Mexico. The Q-5 is powered by an RJ43-3 ramjet, and although a rocket-boost system is available is usually air-launched from B-50s or similar aircraft. It is the fastest target of its size in the world, and is large enough to carry a wide range of transponders and other devices with which it can simulate any known tactical aircraft. Miss-distance cameras and a firing-error indicator are standard equipment. Recovery is effected by a two-stage parachute system and nose spike.

QF-104 Lockheed have converted a number of F-104A Starfighters, withdrawn from USAF Air Defense Command, into radio-controlled drones in order to provide a target capable of flying for prolonged periods at M2 at altitudes greater than 60,000ft. Outwardly distinguished by a prominent aerial system under the centre fuselage, the QF-104 has a new transformer/rectifier system in the nose supplying 200A at 28V of d.c. current. Provision for piloted flight is retained.

NORTH AMERICAN *North American Aviation Inc (Columbus Division), Columbus 16, Ohio.*

Redhead-Roadrunner This versatile target system is being evolved by the Columbus Division against an initial US Army contract for $3.94m which will sustain work well into next year. Pending a satisfactory demonstration of the system a production contract may be let. The Redhead-Roadrunner is to provide a single and cheap recoverable target for controlled missions at subsonic or supersonic speed at any altitude, and to simulate all kinds of flying vehicles during air-defence training on the McGregor range in New Mexico.

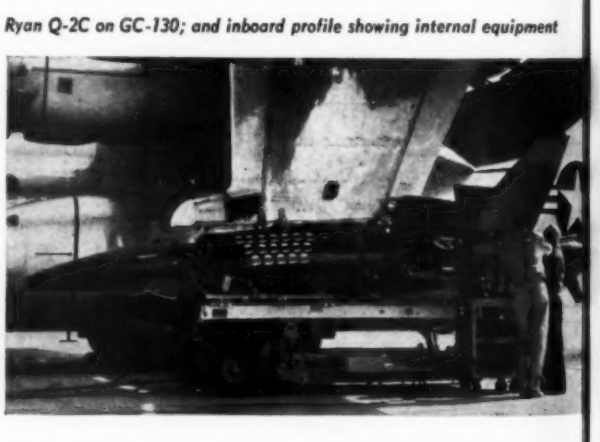
Beneath the slender body is attached a disposable solid boost motor; on top is the sustainer ramjet, by Marquardt. A unique feature is that at low levels full manœuvrability at supersonic speed is achieved without wings, control being accomplished by movable surfaces inclined downwards at 45° from the aft body. For comparable manœuvrability at high altitudes a small delta wing can be quickly attached in the field. The body has an aluminium-alloy rolled skin over the equipment sections and stainless-steel tankage bays; the radomes at either end are of epoxy-impregnated glass fabric, and the aerodynamic surfaces are of aluminium alloy bonded over a balsa core. Recovery is effected by a two-stage parachute system, impact being reduced by a retro-rocket fired by either of a pair of extensible ground-proximity feelers.

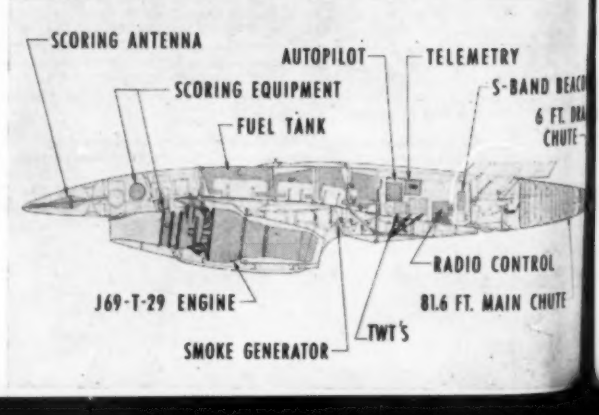
RADIOPLANE *A Division of Northrop Corp, Van Nuys, Cal.*

OQ-19 Many thousands of these simple piston-engined targets have been delivered to the US Air Force, Army and Navy and to other countries including Britain; Radioplane delivered their 50,000th drone during 1959. For many years the OQ-19 family has been one of the world's most widely used targets for anti-aircraft artillery, and it is now fulfilling a similar function in conjunction with batteries equipped with Nike, Hawk and Terrier missiles. The versions in current production and service are the OQ-19B and 19D (USAF and Army) and KD2R-5 (US Navy and Royal Navy), all of which are powered by a McCulloch flat-four two-stroke engine. All versions have a simple and readily repairable light-alloy airframe, and the internal tankage is 9.5 Imp gal. Launching can be effected either by a catapult, by rotary or zero-length launching, or (OQ-19D) by release from a parent aircraft.

Recovery is achieved by a single-stage parachute with a 38ft or (KD2R-5) 32ft canopy, deployed upon command or, automatically, following loss of electric power or radio-command carrier. Flight control is effected by a VHF command system, with automatic stabilization in the case of the OQ-19B. A slightly modified arrangement is employed in the Navy target, which has UHF proportional command guidance. Tracking is accomplished by an X-band radar, and smoke generation

Ryan Q-2C on GC-130; and inboard profile showing internal equipment





TARGETS AND DRONES

Type	Powerplant (aggregate h.p. or (in italics) lb thrust)	Weight (lb)			Dimensions		Mission performance		
		No payload	Laden	With boosts	Span	Length	Speed (m.p.h.)	Altitude (ft)	Endurance (min)*
Australia									
Jindivik 1	Bristol Siddeley Adder (*1,050*)	2,785	2,785	n.a.	19ft 0in	23ft 4in	500+	40,000	45
Jindivik 2	Bristol Siddeley Viper 3 (*1,640*)	2,727	2,877	n.a.	19ft 0in	23ft 4in	544	47,000	36
Jindivik 2B	Bristol Siddeley Viper 8 (*1,750*)	2,720	3,000	n.a.	25ft 8in	23ft 4in	595	55,000	66
Jindivik 3A	Bristol Siddeley Viper 11 (*2,500*)	2,740	3,000	n.a.	25ft 8in	23ft 4in	595	60,000	53
France									
Nord CT-10	Nord pulsejet (*200*)	—	1,410	1,800	14ft 3in	18ft 8in	280	14,000	35
Nord CT-20	Turboméca Marboré (*880*)	—	1,470	2,000	11ft 10in	17ft 9in	560	33,000	45
Nord CT-41	Two Type 625 Nord ramjets	2,865	—	5,622	12ft 3in	32ft 2in	1,650	80,000	14
Great Britain									
EE (Short) Canberra U.10	Two R-R. Avon (*13,000*)	—	40,000	n.a.	64ft 0in	65ft 6in	500	52,000	240
Fairey Firefly U.8	R-R. Griffon 74 (1,965)	—	14,000	n.a.	44ft 6in	38ft 3in	225	10,000	180
Gloster Meteor U.16	Two R-R. Derwent 8 (*7,000*)	—	14,000	n.a.	37ft 2in	43ft 6in	500	40,000	90
USA									
Aerojet SD-2	Lycoming IMO-360-B1B (225)	992	—	1,100+	13ft 3in	16ft 1.5in	345	50,000	—
Aerojet "Improved SD-2"	Lycoming IMO-360-B1B (225)	1,200	—	—	13ft 3in	20ft 0in	350	48,000	—
Aeronca P-106	Aeronca ramrocket	n.a.	n.a.	n.a.	—	18ft 0in	1,300	100,000	—
Beech KDB-1	McCulloch O-150 (120)	478	585	—	12ft 10in	15ft 1in	315	25,000	60
Beech KD2B-1	Rocketdyne twin-chamber rocket	513	560	1,600	3ft 3in	12ft 10in	1,300	70,000	5
Boeing QB-47E	Six GE J47-25 (*43,200*)	—	175,000	n.a.	116ft 0in	—	550	40,000	330
Chance Vought KD2U-1	GE J79-3A (*15,000*)	21,000	23,000	30,000	20ft 6in	57ft 6in	1,400	60,000	60
Fairchild SD-5	P & WA J60-P-5 (*3,000*)	—	8,500	10,000+	24ft 0in	36ft 0in	500	45,000	120
Lockheed Q-5	Marquardt RJ43-3	7,600	—	12,500	10ft 0in	38ft 10in	1,950	80,000	11
Lockheed QF-104A	GE J79-7 (*15,800*)	—	17,000	n.a.	21ft 11in	54ft 9in	1,450	50,000	30
NAA R-Roadrunner	Marquardt RJ	418	958	1,200+	6ft 3in	18ft 10in	1,350	50,000+	—
Radioplane OQ-19	McCulloch O-100 (72)	327	327	400	11ft 6in	12ft 3in	220	23,000	90
Radioplane RP-76	Aerojet 530NS-35 (*530*)	301	301	n.a.	5ft 0in	9ft 8in	900	65,000	9
Radioplane RP-77D	Boeing 502-10F (300)	1,050	—	1,500+	19ft 0in	14ft 10in	410	45,000	60
Radioplane SD-1	McCulloch O-100 (72)	430	450	—	11ft 6in	13ft 5in	185	15,000	40
Radioplane XQ-4B	GE J85-5 (*3,850*)	3,000	3,300	n.a.	13ft 0in	35ft 0in	1,200	70,000	17
Republic SD-4	P & WA J60-P-5 (*3,000*)	—	3,000	4,000+	11ft 0in	32ft 0in	800+	60,000	—
Ryan KDA-4	Fairchild J44-R-20 (*1,000*)	1,400	1,900	—	11ft 2in	17ft 7in	575	40,000	53
Ryan Q-2A	Continental J69-T-19 (*1,000*)	1,400	1,849	—	11ft 2in	17ft 3in	575	40,000	48
Ryan Q-2C	Continental J69-T-29 (*1,700*)	2,060	2,500	—	12ft 11in	22ft 11in	625	59,800	76
Temco XKDT-1	Rocketdyne solid motor (*150*, then *50*)	—	350	n.a.	4ft 11in	11ft 10in	630	50,000	8

**At speed and altitude stated.*

and navigation lights may be employed for visual tracking. To augment the radar echo, wing-tip reflector pods may be fitted.

SD-1 This drone has been developed from the OQ-19 target to meet the needs of the US Army Signal Corps for "an economic, reliable and mobile means of battlefield photography surveillance." The airframe is based on that of the OQ-19B, and the SD-1 may be operated out of sight of the controller from sea level to 15,000ft. Normally 9 × 9 format KA20 (day) or KA53A (night) cameras are used, but an alternative installation comprising three Vinten F95 cameras is under development; all these camera systems are operated on command from the ground control. A single-stage 44ft extended-skirt parachute is deployed for recovery, and equipment includes a DPN-62 beacon and MPQ-29 tracking system and (optional) passive reflector pods. The SD-1 is in operational service with the US Army.

RP-76 Quite unlike any other drone, the RP-76, developed for US Army Ordnance, is a low-cost high-performance target capable of reaching very high altitudes. It is released at height from a standard stores pylon on a fighter aircraft, for use in conjunction with surface-to-air and air-to-air weapon systems. Propulsion is provided by an end-burning solid rocket motor, presently obtained from Standard Oil of Indiana, with nozzles canted 15° outboard on either side behind the wing trailing edge. A great advantage of this propulsion system is that its characteristics can be varied by the fitting of different nozzles to give either higher speeds (M1.26 has been reached) or greater endurance. The steel motor case forms the centre section of the fuselage. Attached to it are the nose and aft-fuselage sections, moulded in reinforced plastics, and the wings, which, with the empennage, are constructed of aluminium honeycomb with bonded aluminium skin. In the nose section is located the automatic flight stabilization system with command-control override, an integral part of which is the trio of control surfaces disposed around the nose.

After being released from its parent aircraft—usually an F-89—the RP-76 climbs rapidly to an altitude of 40,000ft (over 70,000ft has been reached) and there can cruise at M0.9, while returning an enhanced radar echo from a Luneberg lens passive augmenter. The effectiveness of this augmenter was emphasized by the fact that a direct hit was scored by the first Nike Ajax to be launched against one of these targets. Standard equipment includes an RPTA-1 tracking aid system, burst-distance or miss-distance indicators can be fitted, and recovery is effected by a 3ft fist ribbon parachute, supplemented by a second-stage 18ft ring-slot canopy deployed at a predetermined altitude. The RP-76 is now in volume production to meet contracts valued at over $11.5m for 700 targets and associated contractor-operated flight services. A proportion of these targets will be KD4R-1s for the US Navy.

RP-77 Powered by a Boeing 502-10S free-turbine turboprop driving a 52in constant-speed propeller, this target leaves a zero-length ground launcher under the influence of Loki or Falcon boost motors, and thereafter climbs to a maximum operating height of 40,000ft. A Radioplane proportional command control and automatic stabilization system is fitted, operating in the 400Mc/s band. An RPTA-1 airborne tracking system can be used, and wing-tip radar augmentation pods and miss-distance indication equipment can be fitted if required.

Standard fuel capacity is 26 Imp gal; some 10,368 cu in of internal stowage space is available for up to 150lb of payload. This carrying capacity can be augmented by the use of external racks, enabling the RP-77D to be adapted for use in roles other than its primary function of missile and artillery target. Recovery is effected by a 44.5in parabrake, supplemented by a two-stage 63ft ring-sail canopy opening in sequence. All RP-77 contracts have been administered by Army Ordnance, but production has yet to be authorized.

Q-4B For several years this highly sophisticated target has been under development for the US Air Force. In 1955 the original XQ-4s were powered by Rolls-Royce Soar engines, imported by Westinghouse as the J81; these were the first supersonic targets to be flown by the USAF and ten were operated from Holloman AFB in 1958.

They were replaced by the larger XQ-4A (Fairchild J83), which was evolved to provide radar performance compatible with the Bomarc-SAGE defence system, and to serve as a target for all types of surface-to-air and air-to-air weapon systems. Most Q-4As have been launched in the air from B-50 aircraft, thereafter, flying under command control from a ground station. The final version is the Q-4B, in which, owing to the cancellation of the Fairchild engine, the powerplant has been switched to the General Electric J85, rated at 3,840lb with afterburner. Equipment includes radar an IR augmentation, and a scoring system covering a 6,000ft radius from the target. Recovery is effected by a three-stage parachute system. Operational Q-4B drones have reached supersonic speed without afterburner, and are controlled by a miniature gyro system. Inventory deliveries are due next year.

REPUBLIC AVIATION CORPORATION *Farmingdale, LI, NY.*

SD-4 Swallow In October 1958 Republic announced the receipt of a $25m contract from the US Army Signal Corps for the detailed design and production of the very advanced AN/USD-4 combat surveillance drone system. The general manager of the company's guided missiles division (now Missile Systems Division) at Mineola stated at the time that the contract followed submission of a Phase I design stemming from a $3m development contract awarded the previous year. The $25m was to cover 20 SD-4s and two ground guidance stations. During the spring of this year the value of the contract was increased to $30m as the result of a transfer of funds from the defunct SD-3.

Having a tailless delta configuration, the Swallow should achieve supersonic speed on the power of a Pratt & Whitney J60 turbojet, and it will be launched by an underslung solid boost motor from a zero-length launcher on a tracked vehicle, will have either a pre-programmed guidance system or command control from mobile ground or air stations, and will be recovered by parachute.

In June of this year the Lycoming Division of Avco announced the receipt of a contract for the development of the Swallow's accessory-power system. Shaft-power will be extracted from the J60 at between 3,610 and 8,260 r.p.m. and a Lycoming mechanical drive will maintain a constant output speed of 12,000 r.p.m. The system will provide 100A of DC power, 10kVA of AC power and 8 Imp gal/min of hydraulic fluid at 3,000lb/sq in. Energization will be accomplished by a launcher-mounted starter, which will also provide ground check-out power for the airborne systems. The contract requires delivery of the first unit by November 1959, with subsequent deliveries commencing immediately thereafter.

It is stated that the SD-4 will be capable of employing "a variety of advanced sensory techniques . . . including radar, infra-red detection and photography." The contract includes airframe, guidance, data presentation and reduction and the transport vehicle and launcher. No SD-4 has yet flown, but the mock-up board inspection was held late in May and engine runs out of doors with a complete vehicle started late in the summer (2,770lb being achieved with a YJ60-P-2 engine).

RYAN *Ryan Aeronautical Co, San Diego 12, Cal.*

Q-2 Firebee Since 1949 Ryan have been the largest manufacturer of jet-propelled target vehicles in the Western world, and thousands of drones of the Firebee family have been delivered to the US Air Force and Navy. The most important types in current use are the Q-2A and Q-2C of the Air Force and the KDA-4 (generally similar to the

Targets and Drones . . .

Q-2A) of the Navy. All versions are generally similar. The fuselage is a metal monocoque, carrying a Continental J69 or Fairchild J44 turbojet underslung at the forward end; the swept wings and tail surfaces are untapered, and the command-guidance controls the drone through conventional ailerons, elevators and rudder.

On the wing tips are carried Parami electronic pods. These transmit a special radar signal to an oncoming missile, the reflection from which (at a higher frequency) modifies the transmission from the Firebee by pulsing in direct proportion to the missile/target distance. These modified signals are finally transmitted to a ground station and recorded on moving tape to give a continuous running record of miss-distance. The targets themselves are equipped with S-band beacons for response to ground control radar and L-band beacons to provide GCI with a positive position for vectoring fighter aircraft. In addition Traid cameras are installed in Firebees to photograph small missiles.

Each year the Firebee has been chosen as the standard target at the USAF Project William Tell intercepter weapons meet. During the ten-day programme from 80 to 120 Firebees are launched to operate at from 14,000 to more than 50,000ft at speeds of around M0.75. Mean flight duration of the Firebees is normally of the order of 30min, one hour being near the maximum. Peak distance from the ground controller may be as high as 150 miles, and recovery is effected by a parachute system including a 70ft canopy.

The vast majority of Firebees in service are Q-2As with the Air Force, and these are powered by J69-T-19B (Turboméca Marboré) turbojets manufactured under licence. The stabilization system is the RAPS-4A autopilot; tracking and control comprises an MSQ-1 or 1A ground station and an APW-11A airborne radar, and four-channel telemetering is incorporated. In contrast, the KDA-4 is powered by a Fairchild J44-R-20, of similar thrust, and its equipment includes the RAPS-7B stabilization system, command control by UHF radio and an S-band radar beacon. Air launching of both the foregoing types of Firebee is normally accomplished from a GC-130, GB-26, JD-1 or P2V aircraft. The KDA-4, in particular, has frequently been recovered after repeated dunking in the sea.

Now coming into production, the Q-2C has a refined airframe, new equipment and the much more powerful J69-T-29 engine, rated at 1,700lb static thrust. Superficially, the main difference lies in the extended nose radome in which is housed the scoring antennae. The autopilot is the Ryan 12459-2; the tracking system includes APN-91 or DPM-31 (airborne radar) and the same ground set as that used by the Q-2A, while command control is effected by an ARW-55 or FRW-2 transmitter and an ARW-59 receiver.

Owing to the Q-2C's substantially greater weight its recovery system comprises a 6ft drag chute and a main canopy with a diameter of 81ft 7in. Last year an XQ-2C under evaluation at Holloman AFB achieved a radar-measured altitude of 59,000ft, made four simulated runs during 77.5min of remote controlled flight above 50,000ft, and remained in the air for 96.8min, 87.5min of which were under power.

TEMCO *Temco Aircraft Corp, Dallas 22, Texas.*

KDT-1 Teal Under US Navy contract Temco have manufactured an evaluation quantity of cheap, expendable, high-altitude, air-launched targets with a performance comparable to that of potential enemy aircraft. The KDT has a swept wing and a cruciform tail. Structural materials include aluminium honeycomb (aerodynamic surfaces), magnesium (for the main control ring around the motor tube) and glass-fibre for the nose radome.

Launching may be effected from under-wing pylons at any height from sea level to 50,000ft and any speed between 163 and 248kt EAS. Guidance takes the form of a self-contained three-axis autopilot, which maintains track within four miles on either side of the launch heading, and altitude within a 3,000ft corridor. Propulsion is provided by a dual-thrust solid motor, giving 150lb for 4sec and 50lb for the remaining 506sec. Radar reflectors are carried at nose and tail, and a miss-distance indicator is also standard equipment. The self-destructor is energized after nine minutes, or if the target heading deviates from that desired by more than 10deg. Optional equipment includes additional radar corner reflectors and infra-red flares.

CORRESPONDENCE

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. The names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

Civil Transport Accidents List

REGARDING your list published on page 622 of the October 14 issue, it would appear that the compiler has omitted at least one major airline accident, and another one in which only one passenger was killed.

The major accident was the Aeroflot Il-18 crash near Kiev on August 17, the one which "grounded" the Il-18s, and in which all aboard were killed—27 persons. The highly successful ditching of a Northwest DC-7C, reported on page 132 of your July 22 issue, in which only one passenger lost his life out of 51 aboard, is also not included in your June 27 to October 4 table referred to above.

The cumulative total (up to October 4, 1960), therefore, is approximately 965 lives of passengers and crews.

It would be enlightening indeed, if, at the end of the current year, *Flight* could publish another 1960 table of airline accidents in which there were *no* fatalities to passengers and/or crews. Such a table would also provide much food for thought for those of your readers who agree with the opinions expressed by Lord Brabazon and powerful international bodies who are far from convinced (*vide* your editorial "Open Challenge, Open Columns" in your October 21 issue).

Nairobi, Kenya DENNIS M. POWELL

[Our tables comprise accidents to civil transport aircraft, scheduled and non-scheduled, *excluding* the USSR and China, countries which never report accidents except when fatalities to foreign nationals occur. The one fatality in the case of the Northwest DC-7C ditching has been noted.—Ed.]

"Something Old out of India"

"BY ignorance we know things not necessary; by errour we know them falsely." Whoever wrote that might well have been engaged in a nit-picking correspondence long ago; I merely quote it now as an excuse for pointing out that the early biplane illustrated on page 884 of your issue of December 2 is, in fact, an all-steel Henry Farman and not a Voisin.

The all-steel Henry, F.27 in the Farman family, shown under a false name, deserves to have its identity correctly revealed and something of its past recalled. Several F.27s were acquired by the British flying services early in the 1914-1918 War for service in the warmer climes where their all-metal frames (not tail-booms) were considered to be better able to stand up to heat and humidity than the more customary glued-wood structures of the period.

RFC and RNAS all-steel Henrys took part in the German South-west Africa, Gallipoli and Mesopotamian campaigns. The first 500lb bomb was dropped from an F.27 by Cdr C. R. Samson in the Gallipoli campaign, while aircraft of this type, each carrying less than 200lb, dropped 13 tons of food and medical supplies into beleaguered Kut during the Mesopotamian campaign, thus performing what was undoubtedly the first military supply-dropping operation in history.

Although the unprotected steel frames of the F.27 did not warp and shrink they did rust and corrode and were difficult to maintain and repair in the field. Its 140 h.p. Canton-Unné water-cooled radial engine with its vulnerable radiators was another source of trouble. But the all-steel Henry Farman, never used in numbers, had a short and, in retrospect, historic life forty-five or so years ago.

London W1 LEONARD BRIDGMAN

ALL the correspondents who have written to you about the opinions of Roger Bacon and Mr G. Doorpost have replied effectively and competently to those gentlemen's views on historical accuracy. Mr Doorpost's jibes are but an elaboration of Henry Ford's famous epigram that history is bunk; we have heard this sort of thing before and shall doubtless hear it again. Roger Bacon's paragraph came as a shock, however, for reasons of the kind cited by Mr David B. Brown (November 25).

Two facts are indisputable. First, the BBC film *The Flying Years* was lamentably and unforgivably inaccurate (but much of it will be hurled at historians as gospel because Sir Alan Cobham said so-and-so on the telly and it must be true so there see). Second, accuracy is but another name for truth: some of us care for truth; we try, at no small cost to ourselves, to seek it out; not for all the Doorposts in the world would we condone its perversion.

But now we can see the pernicious effect of the sedition preached by R. Bacon and the scorn so liberally poured out by G. Doorpost—or is one or other of these gentlemen responsible for captioning illustrations in *Flight* nowadays? You see, the "Voisin" illustrated on the Correspondence page, December 2, is in fact a Farman F.27.

Birmingham 32 J. M. BRUCE

[The nitpicker correspondence is hereby concluded. The writers' identification cannot be challenged. It would still be interesting to know how the old aeroplane came to find itself in India.—Ed.]

Comfort by BEAGLE?

THERE is no reason why the modern light executive aircraft should not be every bit as comfortable as a car; gone are the days of wrapping up to face the elements, or to protect oneself from oil and grease. I therefore beg Mr Masefield and BEAGLE (whose aerodynamic judgments need no prompting) to bear in mind seating, starting, heating, visibility and accessibility. The test of the last-named quality is the woman passenger. It should not embarrass her (as it often does, unless she is wearing slacks) to get into an aeroplane, and there should be no danger of slipping off a wing. Let's build our executive aeroplane round the occupants, and make it a pleasure for them to drive.

Knutsford, Cheshire EXECUTIVE PILOT

FLIGHT SYSTEM SURVEY

Navaids for Argosy

ORDERS worth a total of £652,000 have been placed by MoA with Marconi's Wireless Telegraph Co for Doppler navigators and ADF receivers for RAF Transport Command Argosy C.1s. Spares and ancillary equipment are included. Of the total, £100,000 covers the AD.712 ADFs, which are crystal controlled, with decade tuning and have fixed-loop aerials.

The Doppler navigator will be the AD2300B, which includes the basic AD2300 senser together with the 5452 computer and 5453 display unit. The computer processes drift and groundspeed derived from the Doppler with heading information from the aircraft compass system and displays left or right displacement from selected track and distance-to-go to the turning point. Steering information is also fed to the flight system or autopilot.

The AD2300 has already been successfully flown in the Dassault Mirage IV supersonic bomber, in which it is combined with a Sperry twin-Rotorace gyro platform to form a Doppler-inertial navigation system. AD2300 is also specified for BOAC Boeing 707s.

Weather Radar in Germany

DECCA Type 41 weather radar has been ordered for the airports at Frankfurt, Hanover, Hamburg, Munich and Schleswig and the installations at Frankfurt and Hamburg are almost complete. The first two units will be evaluated by the German meteorological service during the New Year prior to being taken over by the local aviation weather service. The units at Frankfurt, Hanover and Hamburg are being mounted on special towers, the installation being carried out by Telefunken.

The Type 41 provides accurate and continuous indication of the position, extent and movement of precipitation over an area of many thousands of square miles.

Three-way Transponder Navaid

BOEING has recently issued some details of a new navigation and landing aid employing three-way transponder techniques, the principle being that both ground and airborne equipment derives transponder-type range and bearing information from a double exchange of coded pulses. Spare capacity in the pulses could be employed for passing additional information or instructions, but a data link is suggested to handle remaining information exchanges and to provide voice communications for non-routine messages. The ground-based equipment would employ a standard scanning aerial timed to make six revolutions per minute and to be aligned with north on the hour and at every subsequent ten seconds. Line-of-sight range would be 200 miles. Each ground beacon would have its own code which would trigger the airborne response in the usual way. Aircraft could therefore use one selected beacon, but a general ground-station code might be employed to allow a ground station to interrogate any aircraft within range.

The ground station should be accurate enough to monitor surface traffic on an airfield and the data outputs should be accurate enough to allow collision protection between airborne aircraft.

The airborne equipment would exclude pulses from unwanted ground stations, but would accept appropriate codes and return a pulse coded with the identification of the aircraft. The ground would receive this returned signal and make its range and azimuth measurement in the normal way. It would also return the pulse, still with the aircraft identification, to allow range to be measured by time differentiation in the aircraft and bearing by absolute time comparison with an airborne clock. Because of the sequencing of interrogation and returned signals, only one transmitter and receiver would be required in either ground or airborne units. To these would be attached various data units, including encoder and decoder. Information received on the ground would be fed, with the aircraft identification and supplementary information from data link, into a computer. From here they could be presented in the normal semi-automatic traffic-control displays.

For use as a landing aid, range measurements would be derived in the standard way, but vertical and lateral angular information would be measured by a receiving aerial near the touchdown end of the runway, information being remoted to the tower. A localizer-type aerial could be used to derive centre-line information. It is intended that the pilot should be able to dial a desired glide-path angle in the aircraft and that his equipment should thereafter give him error signals in relation to that glide-path. The approach angle is measured in the ground equipment by a monopulse technique, the angular information being encoded during the time in which the reply pulse is transmitted back to the aircraft. The angular information is transmitted as a code sequence with a small spacing behind the identification. The angular measurement and encoding can be completed during the time between reception of returned pulses from two aircraft spaced on the approach to give maximum landing frequency.

Decca Type 41 weather radar mounted on a tower at Frankfurt Airport. The equipment will indicate precipitation up to 200 miles from the airport and be used for weather forecasting. (News-item in column 1)

Both ground and aircraft identifications are binary codes superimposed as frequency modulation of high-powered pulses and have between nine and 15 positive or negative pulses. They follow the initial pulses, which are always transmitted on the same frequency and therefore have the same polarity. Six carrier frequencies for ground and airborne equipment, with 20Mc/s spacing, would cover navigation and landing requirements. Total frequency band would be 240Mc/s. Time-sharing could be applied to allow one carrier frequency to be used to cover several runways on the same airport.

The glide-path aerial, located 400ft to one side of the touchdown point, is 23½ft high and forms a hyperbolic co-ordinate system, the centre plane of which is 15ft above runway level at the threshold. The aerial is tilted back 0.5° so that the centre plane intersects the runway 1,725ft behind the threshold.

On the approach the aircraft is guided along its selected glide-path angle, but displacements caused by wind gradients are followed by computation of a new glide-path rather than recovery of the old path. At a given range or height relative to touchdown the aircraft is flared toward the centre plane of the co-ordinate system—$K=\theta+\dot{\theta}$, similar to $K=h+\dot{h}$ of the altimeter-controlled flare-out. Because the centre plane is inclined at 0.5°, an aircraft approaching at 230ft/sec will touch the ground at 2ft/sec. The flare will also be made slightly below and almost parallel to the centre plane, because error signals must initiate elevator control, and touchdown will occur between five and seven feet below the centre plane, between 1,000ft and 1,300ft behind the threshold.

A system of this kind would require as many ground stations as now exist for VOR, but Boeing claim that it could be introduced progressively, first as a glide-path perhaps, and would finally greatly simplify airborne equipment.

Vortac at Sea

THE US Coast Guard cutter *Androscroggin*, now anchored at Ocean station Charlie in mid-Atlantic, carries VOR and Tacan mounted on a 75ft-high mast. The object of the tests, according to Interavia Air Letter, is to obtain acceptable signals from a ship which is pitching and rolling. Initial tests were made with the equipment in a ship in Chesapeake Bay, some 25 miles from the experimental centre at Atlantic City.

In the present installation, both the VOR and Tacan are compensated for changes in ship's heading and the Tacan has a counterpoise to correct for up to 20° of roll.

"Universal flyweight" seats, ordered by BOAC for installation in Britannias on their cabotage Skycoach service (see accompanying paragraph), now in production by Aircraft Furnishing Ltd

THE INDUSTRY

The Alvis Year

IN his statement accompanying the Alvis Ltd accounts for 1959-60 the chairman, Mr J. J. Parkes, says that production of both the company's 9- and 14-cylinder aero engines for civil and military customers has continued. In addition, Alvis are engaged on a substantial programme involving conversion of earlier marks of engines to the higher-powered, long-stroke type for both Service and commercial operators.

Leonides engines are now in service in some 33 countries, and more are about to go into service with the Royal Malayan Air Force, Royal Jordanian Air Force, Sudan Air Force and elsewhere overseas. Negotiations have been concluded for the manufacture abroad of the 14-cylinder Leonides Major. The output of military vehicles and fire crash tenders has continued, repeat orders for tenders having been received from the RAF and the South African Air Force. Net profit for the year, after providing £292,275 for taxation, is £269,028.

Flyweights for Skycoach

SEATS manufactured by Aircraft Furnishing Ltd, 41 Lonsdale Road, London W11, are being ordered by BOAC for installation in Britannias operating the new cabotage Skycoach service. Known as the "Universal Flyweight" seat, this type has been designed to give generous leg clearance while allowing the seats to be set at 28in pitch. The units, of lightweight tubular construction, incorporate fixed or reclining backs, tip-up seats and tables. Special attention has been paid to stress characteristics in the structure. The principle of design, with the high-tensile steel single monospar (in effect a torque tube), allows energy created to be absorbed in the winding action of the tube.

Aircraft Furnishing Ltd have now been in business for four years and it is stated that in that time the average weight of seats they have produced has gone down from 98 to 57½lb. The Flyweight 300 Series seats incorporate improvements on previous designs and also offer a considerable price reduction.

A curtain of aluminized asbestos cloth manufactured by Turner Bros Asbestos Co Ltd, Rochdale, Lancs, in BEA 800 Series Viscount. The entire fleet has been so equipped, to obviate discomfort caused to pilots through heat generated by the radio equipment

IN BRIEF

H. W. Edghill & Co Ltd have announced with regret that their founder, Mr Howard William Edghill, died in the Royal Surrey County Hospital at Guildford on November 24 at the age of 68.

Mr D. H. Atkinson has been appointed personnel manager for the Ilford region of the Plessey Co Ltd. Before joining Plessey he held a similar appointment with Rolls-Royce Ltd.

A new British Standard for airframe bearings (SP.89 : 1960) has been published and is available from the BSI Sales Branch, 2 Park Street, London W1, price 10s (postage extra to non-subscribers).

Comet 4Cs of Middle East Airlines operating between London and Beirut from January 3 are being furnished with fabrics made by British Replin Ltd, flameproofed by Perrotts (Nicol & Peyton) Ltd.

R. K. Dundas Ltd have sold a D.H. Dove to Horizon Pictures (GB) Ltd, associates of Columbia Pictures. It is to be used by Mr Sam Spiegel, president of those companies, as an executive aircraft during the filming of *Lawrence of Arabia* in the Middle East.

Mr H. M. Davis, BSC, ARIC, AINSTP, who joined Southern Analytical Ltd as chief engineer and director in June this year, will be responsible for the design and development of all the chemical-analysis instrumentation at present manufactured by the company and in contemplation for the future.

Garringtons Ltd, Bromsgrove, Worcs, had a visit recently from officers on a course at the Army Staff College, Camberley, representing ten different countries. They were entertained by the director and manufacturing manager, Mr H. Orford, and other Garrington personnel, and visited departments of the factory, including the finished products division, where "Red Diamond" hand tools are produced. In the aircraft industry, the company are particularly well known for their gas-turbine blades.

Electronic Associates Ltd, Victoria Road, Burgess Hill, Sussex, are now offering a transistorized "do-it-yourself" special-purpose analogue computer which it is claimed will perform a variety of laboratory, engineering and process control computing tasks. Mr Charles J. Marsh, vice-president of Electronic Associates Inc, said that the introduction of the TR-5 mounting unit had made it possible for special-purpose analogue computers to be assembled easily, without the problems usually associated with such a project. PACE solid state analogue computing components simply plug in to the TR-5 unit, where they may be interconnected according to the computing function to be performed.

This large contour-milling machine is used by Vickers-Armstrongs (Aircraft) Ltd for producing a tongue for the wing-root joint on the centre-section panels of the VC10. As well as following the contour of the aerofoil section, the tongue is machined to a varying angle in the spanwise direction. This machine was designed by Vickers at Weybridge, and built by the Coventry Gauge & Tool Co Ltd. Control of the tool-carriage is by a BTH Emotrol unit

The first of TCA's 23 Vickers Vanguard 952s, certificated on December 2, was delivered from Wisley on December 7. It was flown to Montreal via Keflavik and Goose Bay. The pilot was Capt George Lothian (left) TCA's superintendent of flying. With him in this picture is Capt R. Rymer, Vickers senior experimental test pilot, who is assisting TCA with conversion-training. Another picture: page 997

AIR COMMERCE

THE NEW BWIA

A REPORT from Kingston, Jamaica, suggests that the Federal Government of the West Indies is to take over majority ownership of BWIA. Now a wholly owned subsidiary of BOAC, BWIA is to be reconstituted into a new company of which—according to the report—the Federal Government will hold 51 per cent of the shares, the remainder being divided between BOAC and TCA.

This news probably anticipates imminent publication in the West Indies of the report of the commission which, under Sir Frederick Tymms, was appointed last spring to examine the future of civil aviation in the Federation. The commission completed its work during the autumn. Its members comprised: Dr Keith Bradfield, assistant director-general of civil aviation, Australia; Mr Stephen Wheatcroft, economic adviser to BEA; Mr C. S. Sundaram, an aviation economist with ICAO in Montreal; AVM C. McC. Vincent, chairman, Trinidad and Tobago Air Transport Licensing Authority; and Abe Issa, chairman of the Jamaica Tourist Board.

IS YOUTH A CLOSED GROUP?

THE head of American Express in South Africa, Mr Colin Stamp, is seeking support from the Association of South African Travel Agents to get IATA to amend its "affinity" rule. He wants young people to be able to charter out-dated aircraft at fare levels at present open only to groups of travellers who can show an affinity of interest.

"The profitable utilization of still-serviceable aircraft," says Mr Stamp, "presents a problem which, unsolved, can do considerable harm to the airline industry." Speaking of "affinity of interest," Mr Stamp says: "Although many deserving people have been enabled to travel more cheaply by air, airline officials are freely admitting that the present use or misuse of the affinity principle can constitute an increasing threat to their new jet services, since many people now travel in affinity groups who could well afford the normal tourist—or even first-class—fares."

"All that a youngster would need to qualify for a seat on a Youth Flight," Mr Stamp suggests, "would be a certain date on his passport, proclaiming him to be under 21, or whatever age was mutually agreed upon. Such a plan would be by no means difficult to put into operation. It would please the airlines, because if it were universally adopted by all IATA carriers, it would tap for their own benefit the immense new market of young people who cannot yet travel, simply because they cannot afford standard air fares. The airlines would see their piston-engined aircraft flying again, filled with young people, who would be susceptible to their salesmanship and good service and thus potential travellers on their regular jet services after passing the age limit. And the new Youth Flights would draw little traffic from regular services. The plan would please the travel agents, now embattled against the so-called Travel Clubs which offer cheap travel facilities to their members in exchange for payment of a club subscription. I envisage many hundreds of thousands of young people, free to travel the world for the first time, questioning old beliefs and laying the foundations of new and better ones—all because the world's airlines took advantage of this unique problem that has so far baffled them."

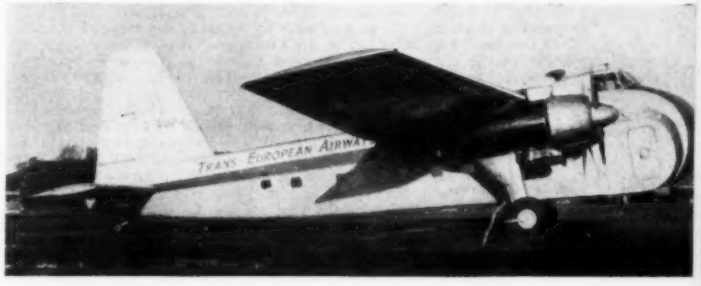
TRANS EUROPEAN EXPANDS

A CONSTELLATION 049 has been bought from an undisclosed American owner by the Coventry-based independent Trans European Airways. It is an ex-Cubana aircraft. This company recently acquired a Bristol Freighter Mk 21 (see photograph right) and is also planning to obtain a Mk 31 in the spring for extending its freight and passenger charter work.

In addition, two Doves have been bought for charter work and it is planned to use them on scheduled services linking Coventry with Birmingham and Newcastle, the Isle of Wight and Swansea and Exeter. The Rapides will be retained for pleasure flights.

Since May 1958, when it began operations from Swansea (until May this year) with two Rapides, Trans European has expanded steadily, and its current re-equipment is in refreshing contrast with the recent demise of other small operators, including Continental, Orion, Air Condor and Don Everall.

Bristol Freighter Mk 21 G-AGPV has been purchased from Air Condor by Trans European Airways of Coventry, the Southend independent that recently ceased operating. A note about Trans European appears above



BEA FEES AND FARES

THE reduced tourist-class fares that BEA plan to introduce on domestic services on April 1 are to be increased by about 3½ per cent on a single ticket as a result of the increased landing fees. International fares will not be affected, nor will there be any increases on tourist services to the Channel Islands and the Isle of Man.

It is estimated by BEA that the Ministry's decision to increase UK landing fees by about a third will cost the corporation about £430,000 a year—£250,000 on domestic services and £180,000 on international routes. The effect is greater on domestic services because, of course, unlike international routes, the increases will apply at both departure and arrival airports. First-class fares will be unchanged. BEA's plan to abolish return-fare discounts as from April 1 on domestic services (single fares becoming half the return fares) still stands.

According to BEA, landing fees for a Viscount 701, now about £16, will go up to £20 next April—more than double the 1956 fee. UK landing fees, BEA are reported to have said, are already the highest in Europe, where comparable figures range from £5 12s 6d in Spain to £13 17s in Austria.

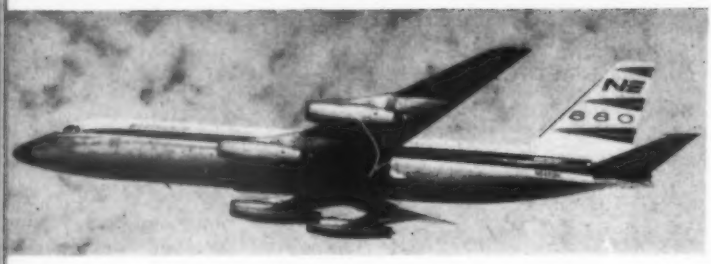
The 3½ per cent increase on the UK single fare from London to Glasgow, for example, will mean that the ticket will cost £5 8s 6d instead of £5 5s. Between 7s and 8s will be added on the return fare [*IATA protest: page 997*].

AEROFLOT THROUGH AMERICAN EYES

FEW Britons have had an insight into the workings of Aeroflot but, largely perhaps as a matter of form, they have invariably withheld public comment. Whenever comment is made it perhaps takes the form of a decorous reference to a "full and frank exchange of views," etc.

Not so restrained was the team of American air transport people which, last September, returned a visit paid to the USA by an Aeroflot team. Some comments were fairly outspoken, and we are indebted to the US magazine *Airlift* for this summary of what some of them said. (The remarks of Mr E. R. Quesada, administrator of the FAA, were summarized in *Flight* for October 28, page 686.)

Mr Stuart G. Tipton, president of the Air Transport Association, considers that "the Russians have lost a lot by being provincial and secretive and by not joining the world airline community." He refers to the "bull sessions" that IATA members have, when one airline may say: "We're having a hell of a time with piston rings," and another will say, "We think we've solved



Northeast are leasing six of the 30 Convair 880s originally ordered by TWA. Here is one of three already in service on daily return flights between Boston and Miami via Philadelphia. Another will follow this month and the last two in February. TWA, incidentally, has now completed the financing of 20 of its 30 Convair 880s and of its existing fleet of 27 Boeing 707s. This follows the placing in trust of the 78 per cent TWA shares owned by Howard Hughes

AIR COMMERCE . . .

our problem and here's what we plan." Mr Tipton finds it hard to conceive of the Russians entering into such discussions, but he thinks that Aeroflot are "conscious of the fact that they have been missing something."

When the Russians were in the USA, Mr Tipton tried to give them a picture of the American airline industry—including facts and figures about traffic. He asked Aeroflot for such figures, but he did not get them. "They are," he says, "remarkably secretive. We were given no figures on the number of passengers carried, or the number of aircraft in the fleet."

When the Russians feel that their facilities are not "up to the snuff," he says, there is a "very great reluctance" to show them. But he thinks that there is a "great deal of drive" within Aeroflot, and a "very considerable determination to make it a tremendous airline."

Mr R. M. Dunn, TWA's v.p. technical services, notes that with the Tu-104's engine cowling open there appears to be about 18-20in working area around the engine. Accessories are not generally mounted on the engine, but appear to be remotely located. Components bear a "striking resemblance" to US designs—fire detectors looked like Edison units, valves like AiResearch components. Machine shops are well equipped.

Mr W. Waldo Lynch, assistant v.p. communications of Pan American, flew the Tu-104, which is not, he says, "in the same ballpark with any of the US jets." Control stick forces are heavy, but the response is positive. Describing Tu-104 take-off, he notes that engines are run up to full power, brakes released, and when the speed of 180km/hr (97kt) is reached "they haul back on the controls" and, he comments, "it takes two." The aircraft lifts off at about 280-290km/hr (150kt), they let it accelerate to 320km/hr, "then clean it up." Cruise is at Mach .79.

Mr Lynch estimates that cruise consumption of the Tu-104 is about 6,000lb per hour per engine. Brakes are good and though tail parachutes are fitted, none was used in any of the five landings he experienced. Finals are long—about ten miles at 300km/hr (160kt) using 30° of flap. Touchdown speed is 280km/hr (150kt) compared with 110-120kt for the big US jets. There is no integration of instruments—ADF is separate and not of the RMI type, but rather the old relative-bearing type. All jet flights are IFR. "Red pilots are good," says Mr Lynch. "They are well trained and the jet pilots average five years in Aeroflot on piston types." Selection for the jets is based on ability, not seniority. Conversion comprises three weeks' ground instruction, 40 hours' flying transition and 40hr on the line as co-pilot. The Aeroflot jet pilot is then cleared, but with ceiling/visibility restrictions of 150/1,500m. After 40-50hr he is again checked. (This is for a Leningrad-area pilot; the Moscow-area is similar except that 50hr transition are required—50 on the line as co-pilot and 64hr additional flying before being rated for standard minima.)

Pilot pay, reports Mr Lynch, is 7,000 roubles per month [about £175 at a realistic exchange-rate], a co-pilot being 70 per cent of this, a navigator 60 per cent and a radio operator 50 per cent. Jet pilots fly 50hr a month, and get 1½ hours' credit for each hour of night flying. An extra 10hr can be flown without pay, with union approval, and this is repaid in the form of time off. Holidays for all flight and cabin crews are 45 days per year.

Mr Lynch says that, "with only a fair airplane and trailing US standards both in facilities and performance, Aeroflot makes up for it with a high degree of effectiveness by picking its best pilots for jet crews."

FALCON AIRWAYS: "NO DIFFICULTIES"

THE following is from Capt M. K. Kozubski, managing director of Falcon Airways. It was received after the correspondence page in this issue had closed for press:—

"I would like to comment on the article which appeared in *Flight* of December 9, page 930, under the heading 'Difficulties of the Non-BIATAs.' In the first instance, I do not know why you have included Falcon Airways under this heading as, indeed, we have no difficulties of the sort mentioned in this article, which therefore gives an entirely wrong and detrimental impression of our company to your readers.

"It is incorrect to say that we have disposed of all our assets to Air Safaris, as the assets disposed of were part of those acquired by us from Airwork some 18 months ago—namely, two Hermes aircraft, and spares and equipment relating to this type of aircraft—all sold in 'as is, where is' condition. The lease of our hangar at Bournemouth (Hurn) Airport was surrendered to the Ministry of Aviation and was subsequently taken over from the Ministry by Air Safaris. I am sure you will agree that every operator has the right to dispose of any equipment no longer required by him.

"You mention also that Falcon Airways was formed by myself 'after the liquidation of Independent and its successor Blue-Air,' and also 'now appears to have ceased operations.' May I advise you of the correct facts? Falcon Airways Ltd was formed in October 1958, incorporated December 3, 1958, and commenced flying operations in March 1959. (No doubt you do realize that it takes a few weeks from the formation of a company to the operating of aircraft.) As far as Independent Air Travel is concerned, I severed my connections with that company in March 1959 and, consequently, it carried out operations under its chairman, Mr A. E. Cooper, MP, and deputy chairman, Air Cdre Sidney Smith, during the summer of 1959. In the latter part of that summer some of the company's aircraft were flying under the name of Blue-Air. In October 1959, Independent Air Travel was, as far as I know, put into voluntary liquidation by its directors and then continued to operate as Blue-Air, again with Mr A. E. Cooper as chairman and Air Cdre Sidney Smith as deputy chairman. Due to the fact that Blue-Air owed money to Falcon Airways for various flights carried out for them, and as we were unable to recover this money, we issued a writ on Blue-Air and, after obtaining judgment, filed a petition for the compulsory liquidation of that company, which was obtained. I was not connected with either Independent Air Travel or Blue-Air at the time of their liquidation.

"I would like to assure you, and your readers, that Falcon Airways is not out of business and, indeed, that we are carrying on business in the normal manner, quite recently having operated flights—although the aircraft flown were not owned by us. I strongly object to your insinuation that we are out of business by your statement that 'of the eleven non-BIATA operators listed on page 758 of *Flight* for November 11, only six now still remain in business; these are Air Safaris, Maitland Drewery, North-South, Overseas, Pegasus and Tradair,' as this is not correct.

"I would like to point out to you the reasons for disposing of part of our assets. They are:—

"(1) Hermes aircraft are not suitable for the type of operation which we intend to undertake. In the past, we carried out certain flights with Hermes but which are not now possible, due to the limitation of two-engine performance currently enforced for flights over water. The bulk of the flights operated by us have been long-range, for which the Hermes is not really satisfactory, as it has insufficient payload over a long range, or cannot operate a long-range flight with full payload. According to our opinion and experience, the Hermes is only suitable and economical for European and Middle East operations.

"(2) Due to the fact that only a small number of licences have been granted to us for operations for which the Hermes is suitable, we felt that it was uneconomical for us to keep these aircraft and, as we had already considered in the past, felt that long-range aircraft were necessary for our operations.

"(3) We released the lease on our hangar at Hurn Airport, as it was not suitable for Constellation aircraft, which we are purchasing, due to its door size. This, of course, meant that we did not need all the personnel who were employed to maintain the Hermes aircraft.

"For your information, a total of 21 employees have been retained by Falcon Airways (which includes most of the aircrew, operations and traffic personnel, administration staff, licensed engineers and stores organization) for operations which we hope will commence in January. An import licence has been obtained from the Board of Trade for the three Constellations and we anticipate importing the first aircraft before Christmas this year. [As reported in the *Flight* article concerned, Falcon Airways are purchasing Constellations from Capital Airlines.—Ed.]

"The maintenance of these aircraft will be contracted to a large servicing organization, such as Fields or Marshalls or a similar company approved by the Air Registration Board, with full liaison from our own licensed engineers and stores personnel. We intend to concentrate in the future on long-range operations and circular tours, including round-the-world tours, most of which will originate from foreign countries such as Switzerland, Sweden, Holland, etc.

"Every effort is being made by our company to comply with the Minister's Regulations to obtain an air operator's certificate, and our operations department is undergoing revision and is being set up to meet all the necessary Ministry requirements.

"This letter is not written in a bad spirit, and I feel sure you will understand the position of myself, the company, its associates and friends."

"WORLD'S MOST EXPENSIVE AIRPORT"

REFRESHINGLY putting his disapproval of his Minister's landing-fee policies on record, BEA's chief executive Mr Anthony Milward said recently in reply to questions: "The Minister of Aviation will have a lot of thinking to do."

It is not, of course, unusual for airlines to complain about landing-fee increases; and now 20 of them operating into London have issued a statement saying that they have asked IATA's director-general, Sir William Hildred, to protest against the one-third landing-fee increase which the Minister of Aviation, Mr Peter Thorneycroft, proposes should take effect on April 1. Sir William is to present their case to him early in the new year.

In a public statement a spokesman for these airlines, Mr R. L. Cole of Pan American, says that the new scale of charges "involves matters of principle which could have world-wide repercussions." He says that the airlines are "seriously concerned by the fact that the proposed new 33 per cent increase—which follows a rise of 50 per cent three years ago and 28 per cent last year—would make London the most expensive airport in the world."

COLOUR-BAR FORMS?

TWICE within the last month the Minister of Aviation, Mr Peter Thorneycroft, and his Parliamentary Secretary, Mr Geoffrey Rippon, have sidestepped Parliamentary questions about the proposed air arrival and departure cards. They say, in effect, that the necessity for these cards is "not a matter for the Ministry of Aviation."

Mr Thorneycroft has to be loyal to the Cabinet, but he and his advisers are in fact believed to be vehemently opposed to what Mr G. R. Chetwynd (Lab, Stockton) described in the House recently as these "exceedingly stupid" forms. Yet the Government intends to go ahead, under an obscure section of the Statistics of Trade Act, 1947, with their introduction—though whether it will still be on January 1 now seems doubtful.

Officially, the Order is laid by the Board of Trade. But even this department is believed to have doubts about the value of traffic statistics which specifically exclude Europe. Who, then, is responsible for inflicting more red tape on an industry already stifled with it, and why?

The finger has to be pointed towards the Home Office and the Commonwealth Relations Office. With the support of the Prime Minister these departments have for two years felt the need for some statistical measure of coloured immigration into the United Kingdom.

It is known that the Government is concerned about the rapidly growing extent of coloured immigration. The Colonial Secretary, Mr McLeod, recently told Parliament that more than 43,000 West Indians have arrived in Britain this year—three times more than in 1959. He said that the Government was studying ways of reducing the flow.

In a leading article recently, the *Daily Mail* said that Britain should think twice before closing its doors to citizens of the Commonwealth and Colonies. By co-incidence or otherwise this article was followed on the same page by another attacking the proposed "ridiculous ritual of form-filling." The *Daily Mail* did not associate coloured immigration with the proposal to introduce the forms nor, to our knowledge, has any other newspaper done so.

Previously, the *Daily Mail* ran a feature article under the heading "DON'T STAND FOR THIS," on the subject of the proposed forms (some of the adjectives used were: idiotic, stupid, fatuous, crass-brained, sordid, half-baked).

It said some very unkind things about one Mr S. R. Walton of the Ministry of Aviation. It alleged that in May 1959 Mr Walton, who was then with the MTCA, had told the airlines that "it was desirous that no news of the proposal should be made public." The article asked: "How is it possible that some nitwit can get the Premier's approval for a half-baked plan when [everybody concerned] is opposed to it?"

Everyone in the airline business is dismayed at the idea of the proposed forms, and will no doubt have been grateful to the *Mail* for its outspoken attack. But it should be put on record that, of all the people in the Ministry of Aviation who are strongly opposed to the introduction of these forms, the most vehement, we believe, is Mr S. R. Walton.

WHEATCROFT'S TEN LESSONS

THE RAeS lecture that was being read by Mr Stephen Wheatcroft, BSC(Econ), AFRAeS, on December 15 had as its title *Economic Lessons from Short-haul Airline Operations*. Mr Wheatcroft, who is economic adviser to BEA and author of the book *The Economics of European Air Transport*, has been concerned during the past two years with economic studies of air transport in Canada, India, Central Africa, the West Indies and, most recently, Nigeria. In each case except Canada the studies have been primarily concerned with relatively short-haul operations within a limited geographical region. His lecture (a summary of which we hope to publish in a future issue) was a summary of what, in his view, are the ten most important lessons to be learned about short-haul economics. The lessons are:—

(1) High-route density leads to lower costs and profitable operations. (2) Highest practicable level of utilization of aircraft and crews is vital. (3) High load factors do not necessarily reflect inadequate capacity and are essential for profitable operations. (4) Aircraft design features—particularly the relationship between passenger payload and maximum payload—have an important bearing on the ability of an airline to achieve high load factors. (5) Flexibility is essential in airline pricing policy to achieve high load factors and the maximum profitable development of traffic. (6) Competition is a double-edged sword. (7) Cross-subsidization of unprofitable routes by profitable routes may be dangerous policy—commercially and socially. (8) Some forms of airline co-operation are highly desirable and may become increasingly necessary in the next few years. (9) Specialization on particular kinds of routes brings great advantages in airline operations. (10) Short-haul airline managements must always look after the pennies.

Footnote: On the previous day Mr Charles Abell, OBE, FRAeS, chief engineer of BOAC, gave a lecture to the Graduates and Students Section entitled *BOAC and the Future*. It is hoped to summarize this also in a later issue.

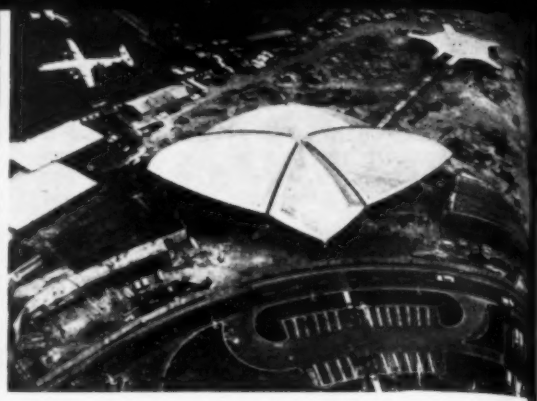
FUTURE OF CYPRUS AIRWAYS

NOW that Cyprus is independent, the future of Cyprus Airways—hitherto an associate of BEA—is a matter for speculation. At Copenhagen last September, *Flight* was told by Mr G. Eliades, the vigorous and youthful (he is 32) chairman of the airline, that he hoped that the association with BEA would continue. Negotiations with another airline, which he could not name, had however been in progress.

It is possible that this other airline was British United Airways; at any rate, Mr M. D. N. Wyatt, the chairman, has recently been in the newly independent Cyprus to discuss—with Archbishop Makarios among others—the future of Cyprus Airways. Lord Douglas, chairman of BEA, has also recently talked with Archbishop Makarios.

Since February 1958 BEA have been running Cyprus Airways services under an agreement which expires on December 31, and is then open for renewal. Using Viscounts and Comet 4Bs BEA maintain Cyprus Airways services from Nicosia; if the existing arrangement is renewed the corporation would use Comets on all routes. BEA holds 22 per cent (43,274 shares) of the issued share capital of Cyprus Airways. In the calendar year 1959, the airline made a profit of nearly £105,000, paying a dividend for the second year in succession.

One of the first assignments undertaken by TCA's newly delivered first Vickers Vanguard was to pose for a group photograph at Montreal with representatives of the airline's other Rolls-Royce-powered partners—a Douglas DC-8-40 and, from the Vanguard's stable, a Viscount 757



Left, a model of Moscow's new international airport, which is now being built near the town of Domodedova. A note about the new airport, which should be open for non-scheduled operations early in the new year, appears in col 2 below. Right, now taking shape—unique shape—at New York International is TWA's terminal building. This is only one of six US airline terminals, each with its own individual styling, built around the main terminal area by Pan American, Northwest, Eastern, United and American

AIR COMMERCE . . .

AIR FRANCE 707 CREWS STRIKE

DESCRIBED by Monsieur Max Hymans, president of Air France, as "nearly a national catastrophe," the strike by all Air France Boeing 707 crews—which is still in force as this issue goes to press—grounded all 17 of the airline's 707s so far delivered. The reason for the strike is the management's insistence that captains accept a ten per cent reduction in hourly bonuses. The pilots have, it is said, already accepted a reduction in salary, following a cut in flying time to 65hr a month. This reduction was made on the recommendations of a medical inquiry.

EUROCONTROL—THE UK JOINS

PROVISION has been made for Eurocontrol to be brought into force when it is ratified by four of the States concerned whose territories form a "coherent whole." The convention was signed (which does not mean ratified) on December 13 by the Minister of Aviation, Mr Peter Thorneycroft, on behalf of the United Kingdom. The other countries who signed, all members of the Common Market, are France, Western Germany, Belgium, the Netherlands and Luxembourg. The Italians are not in Eurocontrol, though they were when the "draft convention" was signed in Rome in June 1959.

The final convention, signed in Brussels—Eurocontrol's HQ—provides for the setting up of "a permanent commission for the safety of air navigation" as well as an Air Traffic Services Agency. Arrangements can be made for the transfer to Eurocontrol (which is initially an upper-airspace authority) of responsibility for the control of lower airspace, presumably with a view to attainment of the ultimate ideal—a Eurocontrol responsible for the whole of the airspace of its members. Meanwhile a branch of Eurocontrol in Paris will study and evaluate requirements.

Provision is made for the inclusion of other countries, which leaves the door open for the Italians. [A note on the aims and objects of Eurocontrol appeared in *Flight* for December 9, page 901.]

MOSCOW'S NEW AIRPORT

THE runways of the new Moscow international airport now being built near Domodedovo have been completed, and construction of the hangars and operations building is well advanced. The airport will be capable of handling "several thousand passengers an hour," their transfer to and from the aircraft being organized on what a Russian source describes as "new lines, along platform galleries ending alongside the aircraft, in such a way that 14 aircraft can be emptied or loaded simultaneously." This, of course, is the finger system—which has incidentally been discarded at the new airport now being built for the capital of the USA (Washington Dulles).

The terminal building will contain the usual airline offices and public amenities and there will be luxurious waiting rooms fitted with radio and wide-screen television for entertainment, and with illuminated indicators for information. There will be a large restaurant and, for those who require it, hotel accommodation. Everything is to be in "the most artistic taste."

Access to Moscow will be by road, electric train and helicopter, and provision is being made for a monorail link with the city. It is expected that the airport will be open for non-scheduled operations next spring.

THE DC-3 IS TWENTY-FIVE (continued from page 985)

post-war "low." This is not to say, of course, that less drastic modifications and improvements to the DC-3 have not been popular. Many small changes have been made, and layouts taking up to 32 passengers (and, in under-developed areas, even 40 to 45) are in widespread use. Many specialized conversions, such as elaborate layouts for executive use in the United States and modifications to meet various airline programmes—(e.g., BEA's Pionairs in Britain) have been adopted; but, in all its essentials, the DC-3 has remained little changed from the form in which it was first sold before the war.

The type has gained its fame primarily as an airliner, civil freighter and military transport, but this has by no means been the limit of its achievements. For countless military and civil applications, under every conceivable condition of climate and geographical environment, it has made, and continues to make, its mark. As an experimental vehicle in which to test equipment of every kind; as an engine test-bed; for survey and exploration (DC-3s were the first aircraft to land at both North and South Poles): for research and training; as a luxurious executive transport; for charter work and agricultural duties; for all these and for innumerable other tasks the DC-3 still does a job which few aircraft can perform more effectively. Indeed, it is not too much to say that it still stands supreme where a combination of ease of operation, ruggedness, reliability, adaptability, safety and economy are the qualities required.

It has been estimated that DC-3s have to date carried some 600 million passengers and have flown about 7,000 million miles in perhaps 50 million hours. Probably somewhere between 4,000 and 5,000 are still flying—nearly half the total number built—and among them about 1,650 are still in regular daily scheduled commercial service with about 235 airlines. The USAF itself still operates 1,200 military models of the DC-3 and a good many hundred more are used by large and small air forces all over the world. In executive, charter and other commercial uses, hundreds of other DC-3s add to the total. In Russia, similarly, hundreds of Li-2s are still airworthy. It is not surprising that, although they went out of production with the type fifteen years ago, Douglas still make and sell about a million dollars (£360,000) worth of DC-3 spares annually. Because of this, good second-hand DC-3s still cost today anything between $50,000 and $260,000 (£18,000 to £93,000), depending on their condition and the elaborateness of their furnishings and equipment. Not bad going for aircraft which cost no more—and often far less—when purchased new 25 years ago! All this goes to show that the Douglas Commercial Number Three is without question the most successful aeroplane ever built.

DOUGLAS DC-3

Powerplant: the first DC-3s were powered by two Wright Cyclone R-1820 G-series single-row radials each rated at 1,000 h.p., but the thousands of military versions all had the 1,200 h.p. Pratt & Whitney R-1830 Twin Wasp. Current models are generally powered by the R-1830-92, driving 11ft 6in Hamilton Standard Hydromatic propellers.

Dimensions: Span, 95ft; length, 64ft 6in; height, 16ft 11.5in; track, 18ft 6in; wing area, 987 sq ft.

Weights: Max, US passenger, 25,200lb; max, US freight, 26,900lb; max, UK, 28,000lb; landing, US passenger, 24,400lb; landing, US freight and UK, 26,900lb; zero-fuel, no restriction; capacity payload, 5,380-6,570lb; weight less fuel and payload (basic operating), 17,720lb.

Performance [source, Appendix 12, BEA Report 1959-60]: Continuous cruising speed at 6,000ft and 27,000lb, 143kt (165 m.p.h.); corresponding consumption at 550 h.p. per engine, 73.5 Imp gal/hr; balanced field length, max wt, sea-level, ISA, 4,050ft; landing distance from 50ft, 1,980ft; operating sector distance with max payload, 304 n.m. (350 st. miles); range with max fuel (670 Imp gal), and payload of 3,500lb, 1,190 n.m. (1,370 st miles).

"THE CROWDED SKY"

NOT all that many years ago, airline flying as portrayed by the cinema was a dramatically hazardous business. The overplaying of these hazards—long after airline flying became safer than crossing the road—tended to irritate. Happily, the cinema in recent years has only rarely abused air transport with stunts and sensations, and its treatment of the subject (as witness *No Highway* and *Cone of Silence*) have been thoughtful and responsible pieces of entertainment.

Now we are offered by Warner Brothers a film, *The Crowded Sky*, which once again might make the public feel that airline flying is dangerous. But it is difficult to be irritated, because the subject is one which professional airline people themselves regard very seriously—the increasing dangers of collision. This film tells the story of a DC-7 of Trans-States Airlines (a real DC-7 with a special paint job) and a US Navy T-33. It is inevitable—from the point of view of the story, if not reality—that the two aircraft must eventually collide. As the two flights proceed, the DC-7 from right to left of the screen and the T-33 from left to right, flashbacks look into the lives of those on board.

And pretty mixed-up lives some of them are. The Trans-States DC-7 skipper is Dana Andrews, who Never Made A Mistake, who always flew by the book, but who on this flight was above his assigned flight level [230] "to give the geese a smoother ride." His co-pilot is John (*South Pacific*) Kerr, who has a grudge against the captain because he once refused to recommend him for another ring. He does not like girls, though the stewardess (played by Anne Francis) eventually succeeded in "blasting off" with him before the fateful flight.

The T-33 is at the wrong height also, because of a radio failure. Suddenly the air traffic control centre radar operator (who has personal problems, too) spots two dots on a collision course. Perhaps the DC-7 should have been advised to change course rather than height; but the collision—most realistically portrayed—occurs. The jet explodes, the DC-7 has two engines on fire and, through a hole in the fuselage made by a runaway propeller, its flight engineer is lost. The emergency descent and landing provide moments of real drama, and are convincingly filmed—presumably with models, though it is hard to tell.

Before an FAA inquiry Dana Andrews admits he made a mistake, thus purging himself of the infallibility that has made him such a difficult man to work with. Perhaps now he will accept the desk that the airline's president unsuccessfully "threw at him" earlier. Similarly, as a result of the accident, everyone else's problems appear to become resolved—except for the pupil and instructor in the jet, who are dead.

"There are 2,000 near misses every year in the USA," is one bit of dialogue. Another, from the pupil in the T-33, is: "They say the sky is crowded, but it looks pretty empty to me."

Perhaps some will feel that the collision risk has been overdramatized. But until it is no longer a cause for concern in the airline business, there may be other films like *The Crowded Sky*.

J. M. R.

BREVITIES

Membership of ICAO rose from 80 to 83 earlier this month with the addition of Mali, Senegal and Nigeria.

Overseas Aviation's engineering base at Gatwick is now an ARB-approved inspection organization. The chief inspector is R. B. Tolley, and P. Taylor is chief engineer.

A terminal building double the size of the existing one is to be built at a cost of £1.6m at Jan Smuts Airport. It should be ready in 1965, when the present terminal building will be used for domestic services only.

Since our note of December 9 about the need, in BOAC's view, for Manchester Airport's main runway (06/24, 7,000ft) to be lengthened by about 500ft, it is announced that work is to start "as soon as possible" on such an extension. The cost will be about £35,000. A further £25,000 will be spent grooving the main runway to increase braking power, and to help clear the water in wet weather. Both these proposals meet the suggestions made by BOAC.

BKS have applied to the ATAC for an exchange of services with BEA: the independent wants to transfer its Southend/London - Oporto service via Bordeaux or Dinard with BEA's London - Bordeaux/Biarritz service so as to enable BKS to operate direct flights between London and Biarritz at two-sevenths of the combined frequency operated by both parties on services terminating at that point. Skyways are also applying to operate four return daily flights between Luton and Beauvais with aircraft chartered from Autair.

The Guild of Air Pilots and Air Navigators held an investiture and Livery Dinner at Innholders' Hall on Wednesday, December 7. The Master, Dr K. G. Bergin, presided. The following were invested with the Livery: Wg Cdr J. E. Bazalgette, Lord Brabazon of Tara, Capt E. B. Fielden, Gp Capt the Earl of Gosford, Mr B. A. Loveridge, Mr P. E. D. Moore, Mr J. E. Rylands, and Mr M. A. Smith. Other Liverymen present at the dinner included: Marshal of the RAF Sir Dermot Boyle, Sir Alan Cobham, Air Chief Marshal the Hon Sir Ralph Cochrane, Sir George Edwards, Rear-Admiral Sir Matthew Slattery, Mr Basil Smallpeice, Sir Frederick Tymms, and Mr C. F. Unwins.

Aerolineas Argentinas recently stated that it is closely studying the possibility of extending its Europe-bound Comet 4 flights to the Middle East, to serve the Lebanon and the UAR.

A DC-3 owned by Airlines of New South Wales was lost on a training flight off the New South Wales coast on December 12. There were three pilots on board.

United Arab Airlines (formerly Misrair) have opened new offices in Accra, Ghana, under the direction of Mr Mohamed Abdel Halim Khalifa. UAA's Comet 4Cs are to open a service to Accra from Cairo via Kano and Lagos on January 1.

Hermes G-ALDA of Air Safaris, one of the two recently bought from Falcon Airways, overshot the runway on a training flight at Gatwick on December 12 after the take-off was abandoned. The pilot was Capt de Bourneville. Damage was not extensive and there were no injuries.

Due to make its first flight any day now is the Caravelle which has been fitted with G.E. CJ-805-23C turbofans (16,100lb static thrust each). The nacelles have been designed and built by Douglas. The FAA flight test programme will begin early in 1961 with a view to certification of the Caravelle 7.

Just published is a new edition of IATA's code regulating the packaging, labelling, handling and stowage of special cargoes. Now in book form for the first time, it is entitled *IATA Regulations Relating to the Carriage of Restricted Articles*, and it is available at $4.00 (US) from IATA at 1060 University Street, Montreal 3, Canada.

According to Mr R. M. Dunn, vice-president, technical services, of TWA, the accident to the Il-18 was caused by combustor nozzle flame impinging on the wall of the combustor, burning a hole through the can and causing a wing fire. Mr Dunn was a member of the American exchange visit team recently in the USSR (see pages 995 and 996).

Direct BOAC flights to Philadelphia, Washington and Baltimore, in addition to the existing gateways of Boston and New York, will be allowed if the CAB accepts its Examiner's recommendation for the issue of a foreign air carrier to BOAC to permit the addition of Philadelphia, Baltimore and Washington "as additional co-terminal points and modify the authorization of Boston from that of an intermediate point to a co-terminal point." This is in any case a mere formality, as these destinations (as well as Detroit and Chicago) are already provided for in Route 2 of the UK/US air agreement.

1st Offr Thomas Bennett of TAA has been awarded the George Medal. On a flight from Sydney to Brisbane a passenger, armed with a sawn-off automatic rifle and two sticks of gelignite fused with electric detonators, told 1st Offr Bennett that unless the aircraft was diverted to Singapore he would blow it up. 1st Offr Bennett said he had to check the fuel, returned to the cockpit and was ordered to disarm the man at all costs. He went back to the cabin with another TAA pilot who was travelling as a passenger. While this pilot distracted the gunman's attention 1st Offr Bennett wrenched the gelignite out of his grasp. The gun went off but the bullet went through the roof. The aircraft landed safely.

Left, a certificate of commendation was recently awarded by Sir Matthew Slattery, BOAC's chairman, to Capt A. S. Powell for "outstanding qualities of leadership and airmanship" when he safely landed a Britannia 102 aircraft at Khartoum with a retracted undercarriage on November 11. Capt Powell was also presented with a silver cigarette box. Right, at the controls of BEA's first Vickers Vanguard (which as this issue went to press was due to be carrying its first fare-paying passengers) is the BEA Vanguard flight manager, Capt A. S. Johnson

Gloster Javelins from No 228 OCU over the Northumberland coast, three FAW.5s with a T.3 occupying the box position

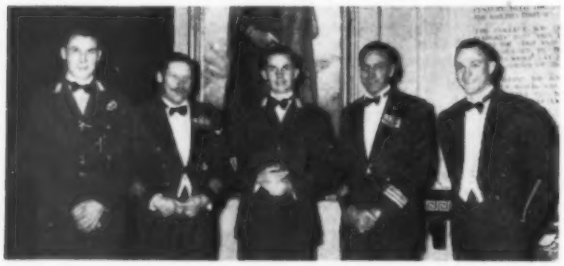
"Flight" photograph

SERVICE AVIATION

Air Force, Naval and Army Flying News

Aircraft Engineering Director

AN ex-Halton apprentice, Gp Capt S. W. Lane has recently become Director of Aircraft Engineering at Air Ministry, with the acting rank of air commodore. He was previously (until last August) with the MoA as Chief Aircraft Supplies Liaison Officer, and prior to that Senior Technical Staff Officer at the headquarters of No 41 (Maintenance) Group.



AVM E. W. S. Jacklin (second from left), CAS, Royal Rhodesian Air Force, at a Cranwell guest night during his recent visit to the RAF. With him (left to right) are FC P. V. Pile, FC P. E. Busfield, Wg Cdr P. E. Stableford and SUO A. A. MacKay

India's Auxiliaries

WITH the RAuxAF almost completely disbanded, it is interesting to learn of an up-and-coming Auxiliary Air Force in India. "This organization" (writes a correspondent) "selects and trains young men to become full-fledged pilots, technical officers and airmen. Over 12 pilots, 15 airmen and a technical officer are selected every year to undergo training with the squadrons of this force functioning in various parts of the country. So far, seven squadrons have been raised—in Delhi, Bombay, Madras, Uttar Pradesh, Bengal, Orissa and the Punjab. The ultimate objective is to have a squadron of the Auxiliary Air Force in each State."

Trumping the Ace

LAST Sea Hawk squadron in front-line service with the Royal Navy, No 806 was disbanded at RNAS Brawdy on December 15. The farewell ceremony was attended by Rear Admiral F. H. E. Hopkins, FOFT, and officers who had previously served with the squadron. Commanded by Lt Cdr W. W. Illingworth, No 806 returned from service in the Far East in HMS *Albion*, which docked at Portsmouth on December 17. The carrier is being converted next year as the Royal Navy's second Commando carrier and her homecoming marks the departure from front-line RN service not only of the Sea Hawk, but also of Sea Venoms and Skyraiders.

No 806 was first formed at Eastleigh in February 1940 with eight Skuas and four Rocs, under the command of Lt Cdr (now Admiral) C. L. G. Evans. It was at Brawdy in March 1953 that the squadron, then commanded by Lt Cdr P. C. S. Chilton, became the first unit to be re-armed with Sea Hawks and adopted the Ace of Diamonds as its badge. During the war the squadron served in the Mediterranean, successively in HMS *Illustrious*, *Formidable* and *Indomitable*.

"Inescapable Changes"

IT was announced by the Air Minister, Mr. Julian Amery, on December 9 that the remaining 11 fighter control units of the RAuxAF are to be disbanded. In a written Parliamentary answer Mr Amery said: "Reorganization of the control and reporting system and the introduction of new air defence techniques have resulted in a reduction in manpower needs, and the continued employment of Auxiliaries in this role is thus no longer justified. Very careful consideration has been given to the employment of the units in other roles, but this has proved impracticable."

FCUs being disbanded on January 31 next year are: Nos 305 (East Riding); 3506 (County of Northampton); 3508 (County of Northumberland); 3511 (City of Dundee); 3604 (County of Middlesex); 3609 (West Riding); 3612 (County of Aberdeen); 3617 (County of Hampshire); 3618 (County of Sussex); 3619 (County of Suffolk); and 3620 (County of Norfolk).

The Air Minister added: "I should like to take this opportunity of expressing the sincere thanks of the Air Council to the members of the Royal Auxiliary Air Force for the voluntary service they have given to the nation. They have made a valuable contribution to our security in the past, and it is only inescapable changes in defence techniques which have led us to this decision."

The CAS, Air Chief Marshal Sir Thomas Pike, during his recent visit to the RAF in Cyprus, with Wg Cdr P. Ainley (right), OC No 70 Sqn

No 87's Farewell

"A CORDIAL welcome" has been extended by the commanding officer of No 87 Sqn, Wg Cdr G. C. Lamb, to former members to attend a ceremonial parade and farewell party at Bruggen on January 3 on the occasion of the squadron's disbandment. The C-in-C Royal Air Force Germany, Air Marshal Sir Humphrey Edwardes Jones, is taking the salute at the parade.

No 87 was the first RAF squadron in Germany to get Javelins, being converted from Meteor NF.11s in 1957. During the Second World War it operated Hurricanes and then Spitfires; in the 1914-18 War its equipment was successively Sopwith Pups, Camels and Dolphins.

Those former members who would like to attend the parade (1130hr) and disbandment party are asked to communicate with Wg Cdr G. C. Lamb, AFC, Officer Commanding No 87 Sqn, RAF Bruggen, BFPO 40, as soon as possible.

IN BRIEF

Sea Vixens, Scimitars and Gannets of HMS *Hermes* took part in a demonstration for sheiks and sultans of the Aden Protectorates in a "shop window" display by the Royal Navy off Aden on December 12.

A complete fuselage built by RAF technicians will enable 35 youngsters at a time to make a simulated flight in a Transport Command aircraft on the RAF stand at the 34th National Schoolboys' Own Exhibition, which opens at Olympia, London, next Tuesday (December 27) and continues until January 7.

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